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Kusumoto

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(45) **Date of Patent: *Feb. 26, 2002**

(54) **IMAGE FORMING APPARATUS CAPABLE OF CONTINUOUS OPERATION AFTER MALFUNCTION CORRECTION**

(75) Inventor: **Keiji Kusumoto**, Toyokawa (JP)

(73) Assignee: **Minolta Co., Ltd.**, Osaka (JP)

(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(30) **Foreign Application Priority Data**

Jul. 22, 1997 (JP) 9-195332

(51) **Int. Cl.**[7] **B41B 19/00**
(52) **U.S. Cl.** **358/1.14**; 358/1.15; 358/437
(58) **Field of Search** 358/1.14, 1.15, 358/437, 1.9

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Primary Examiner—David Moore
Assistant Examiner—Kevin C Kianni
(74) *Attorney, Agent, or Firm*—Sidley Austin Brown & Wood

(57) **ABSTRACT**

The image data are transmitted to an external device connected to the network in conjunction with a paper jam, predetermined paper supply condition such as a paper empty condition, or other abnormal condition. In this way jobs are not erased unbeknownst to an operator when power is automatically shut OFF due to lack of operation for a predetermined time following a print operation stoppage, or when power is shut OFF in conjunction with the correction of a paper jam or other abnormal condition. When the cause of the image data transmission has been corrected or when power is restored to the digital copier, the image data previously transmitted to an external device on the network are returned to the digital copier. In this way printing can be easily restarted by executing a restart continuous operation process without requiring an operator to again input image data in order to restart printing.

29 Claims, 23 Drawing Sheets

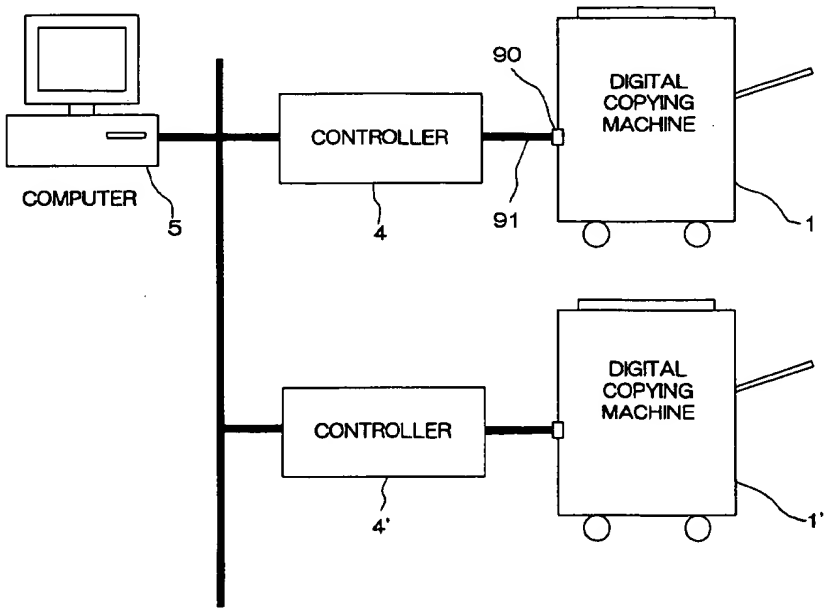


Fig.1

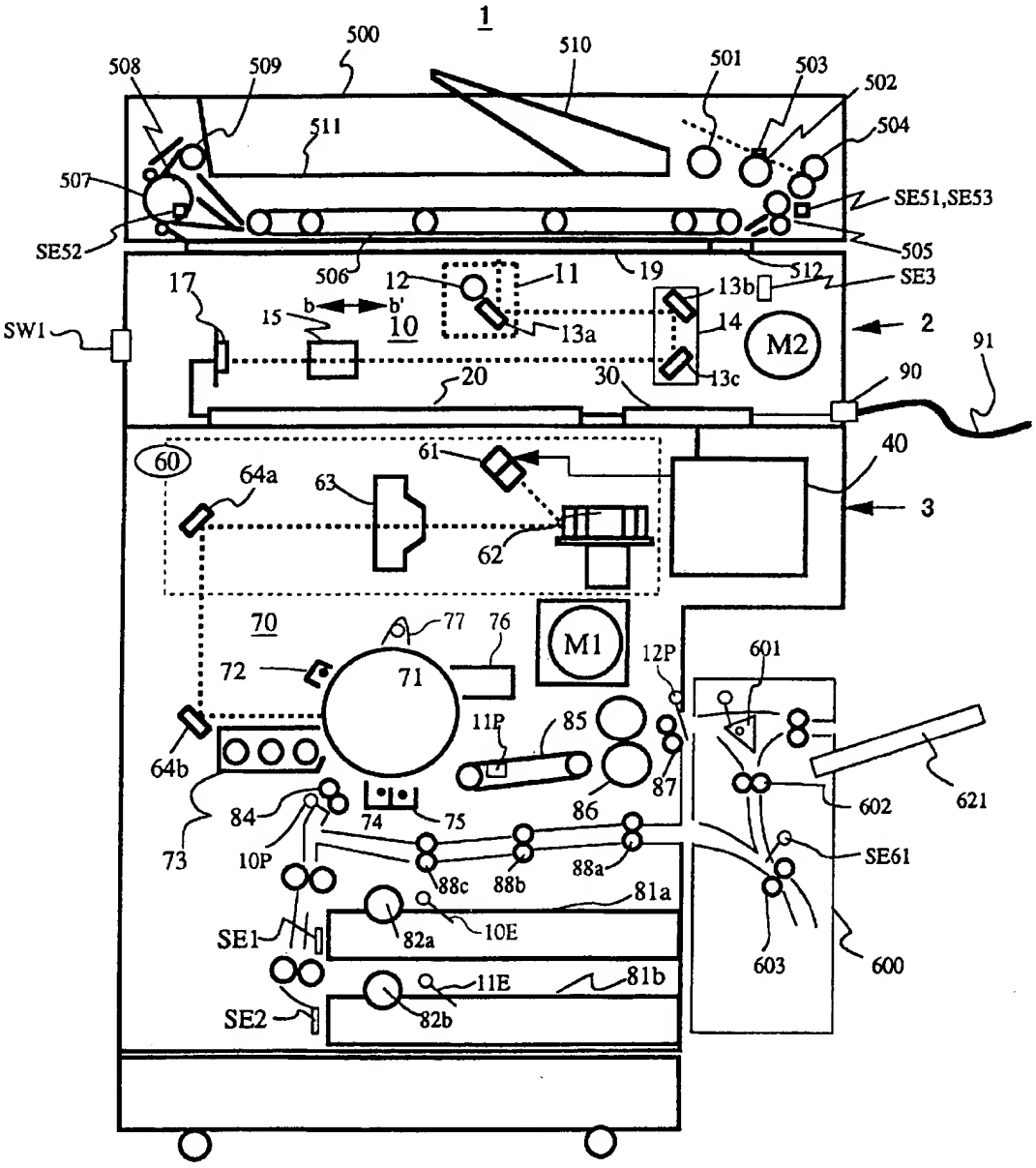
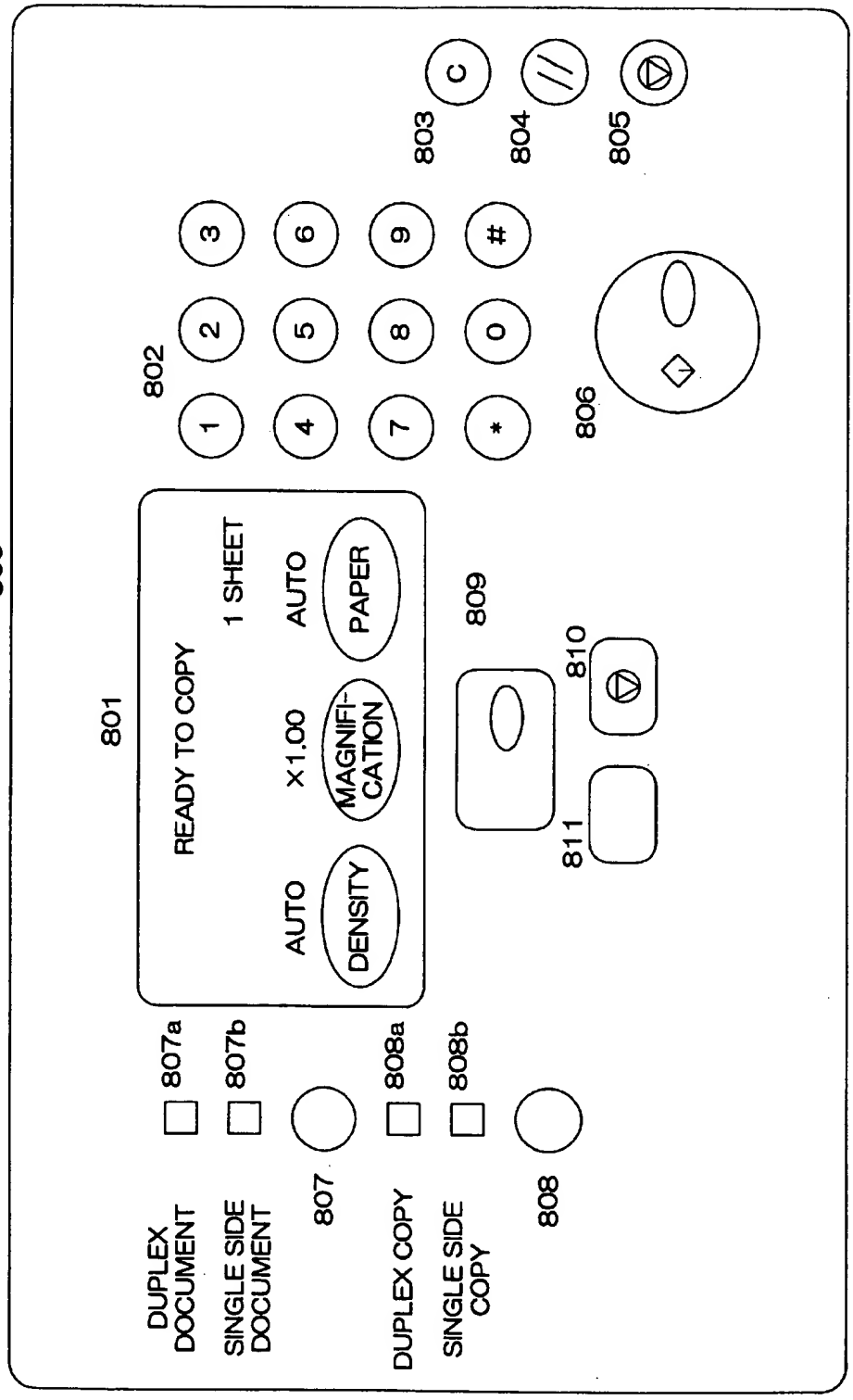

1
500
508
509
510
501
503
502
504
511
507
SE51,SE53
SE52
505
506
12
11
19
512
SE3
17
13b
b
b'
15
10
13a
14
M2
2
SW1
91
20
30
90
60
61
40
64a
63
3
62
70
77
76
M1
12P
601
72
71
11P
85
64b
87
602
621
84
74
75
86
73
10P
88c
88b
88a
SE61
81a
SE1
82a
10E
603
600
11E
81b
SE2
82b

Fig.2


800
801
READY TO COPY
1 SHEET
AUTO
PAPER
×1.00
MAGNIFI-CATION
AUTO
DENSITY
802
1
2
3
4
5
6
7
8
9
*
0
#
803
C
804
805
806
807a
807b
807
808a
808b
808
DUPLEX DOCUMENT
SINGLE SIDE DOCUMENT
DUPLEX COPY
SINGLE SIDE COPY
809
810
811

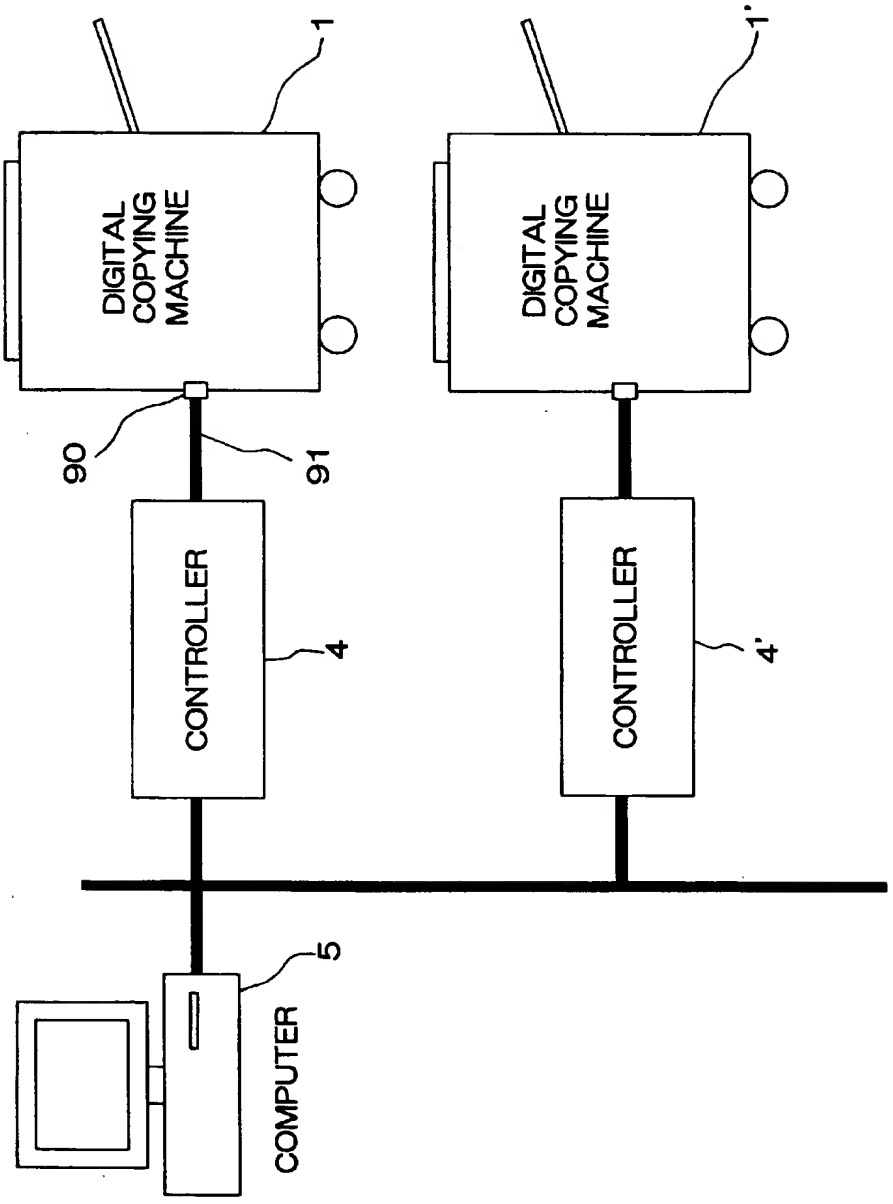
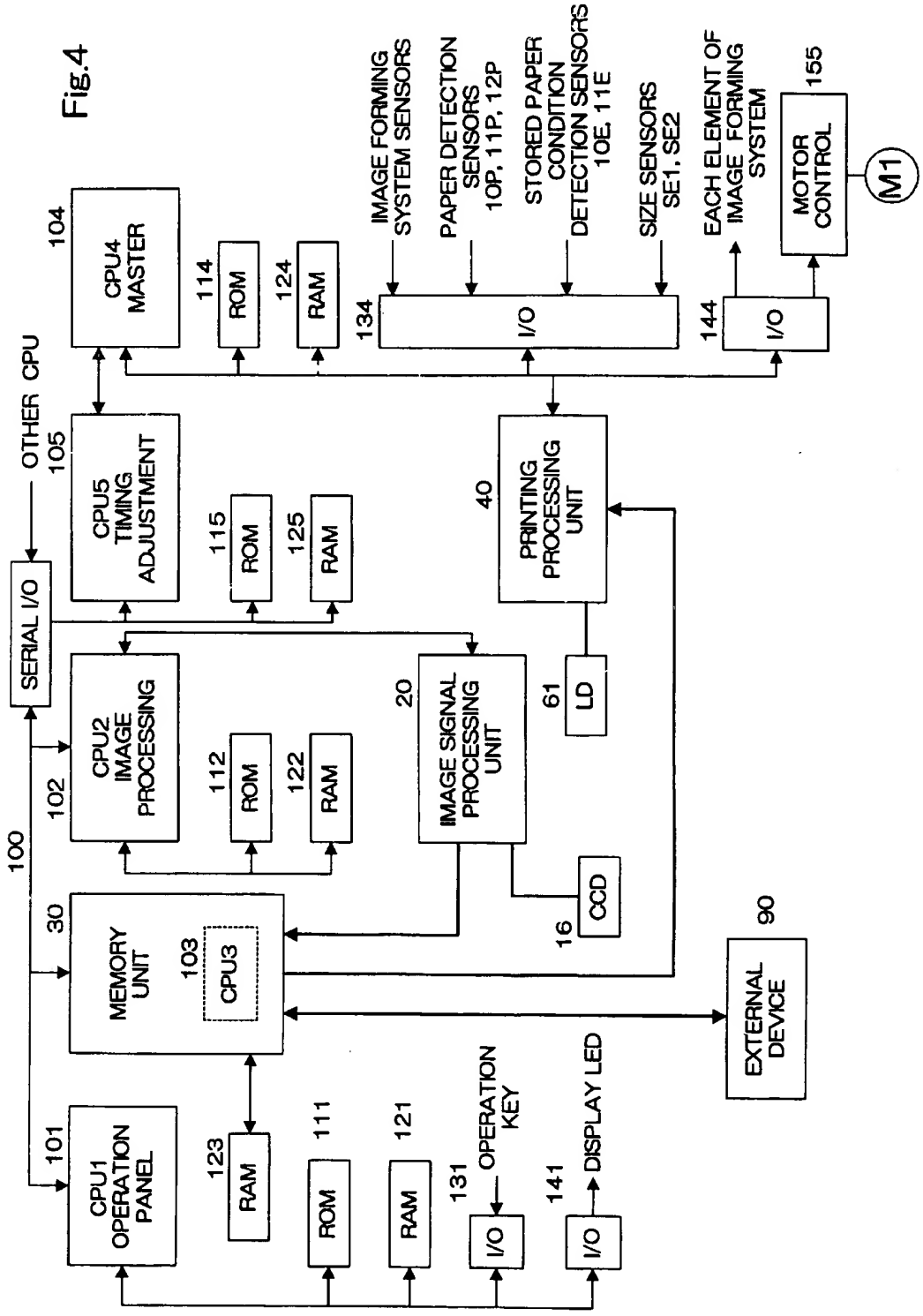

DIGITAL COPYING MACHINE
1
DIGITAL COPYING MACHINE
1'
90
91
CONTROLLER
4
CONTROLLER
4'
5
COMPUTER

Fig.3

Fig.4


100
CPU1 OPERATION PANEL
101
CPU2 IMAGE PROCESSING
102
CPU3
103
CPU4 MASTER
104
CPU5 TIMING ADJUSTMENT
105
OTHER CPU
SERIAL I/O
MEMORY UNIT
30
ROM
111
RAM
112
ROM
114
ROM
115
RAM
121
RAM
122
RAM
123
RAM
124
RAM
125
I/O
131
OPERATION KEY
I/O
134
I/O
141
DISPLAY LED
I/O
144
IMAGE SIGNAL PROCESSING UNIT
20
PRINTING PROCESSING UNIT
40
CCD
16
LD
61
EXTERNAL DEVICE
90
IMAGE FORMING SYSTEM SENSORS
PAPER DETECTION SENSORS 10P, 11P, 12P
STORED PAPER CONDITION DETECTION SENSORS 10E, 11E
SIZE SENSORS SE1, SE2
EACH ELEMENT OF IMAGE FORMING SYSTEM
MOTOR CONTROL
155
M1

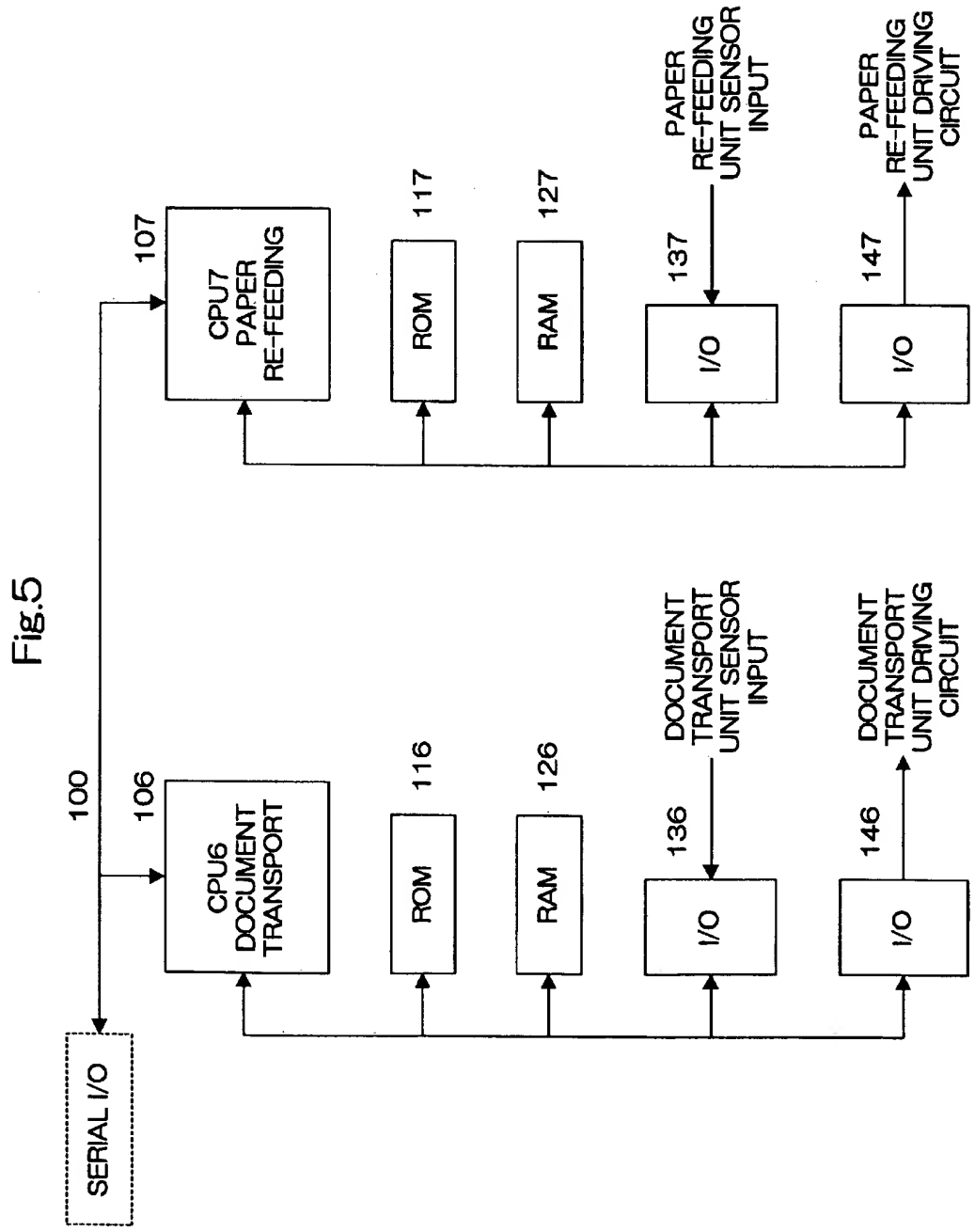

100
SERIAL I/O
106
CPU6
DOCUMENT
TRANSPORT
116
ROM
126
RAM
136
I/O
DOCUMENT
TRANSPORT
UNIT SENSOR
INPUT
146
I/O
DOCUMENT
TRANSPORT
UNIT DRIVING
CIRCUIT
107
CPU7
PAPER
RE-FEEDING
117
ROM
127
RAM
137
I/O
PAPER
RE-FEEDING
UNIT SENSOR
INPUT
147
I/O
PAPER
RE-FEEDING
UNIT DRIVING
CIRCUIT

Fig.5

Fig.6

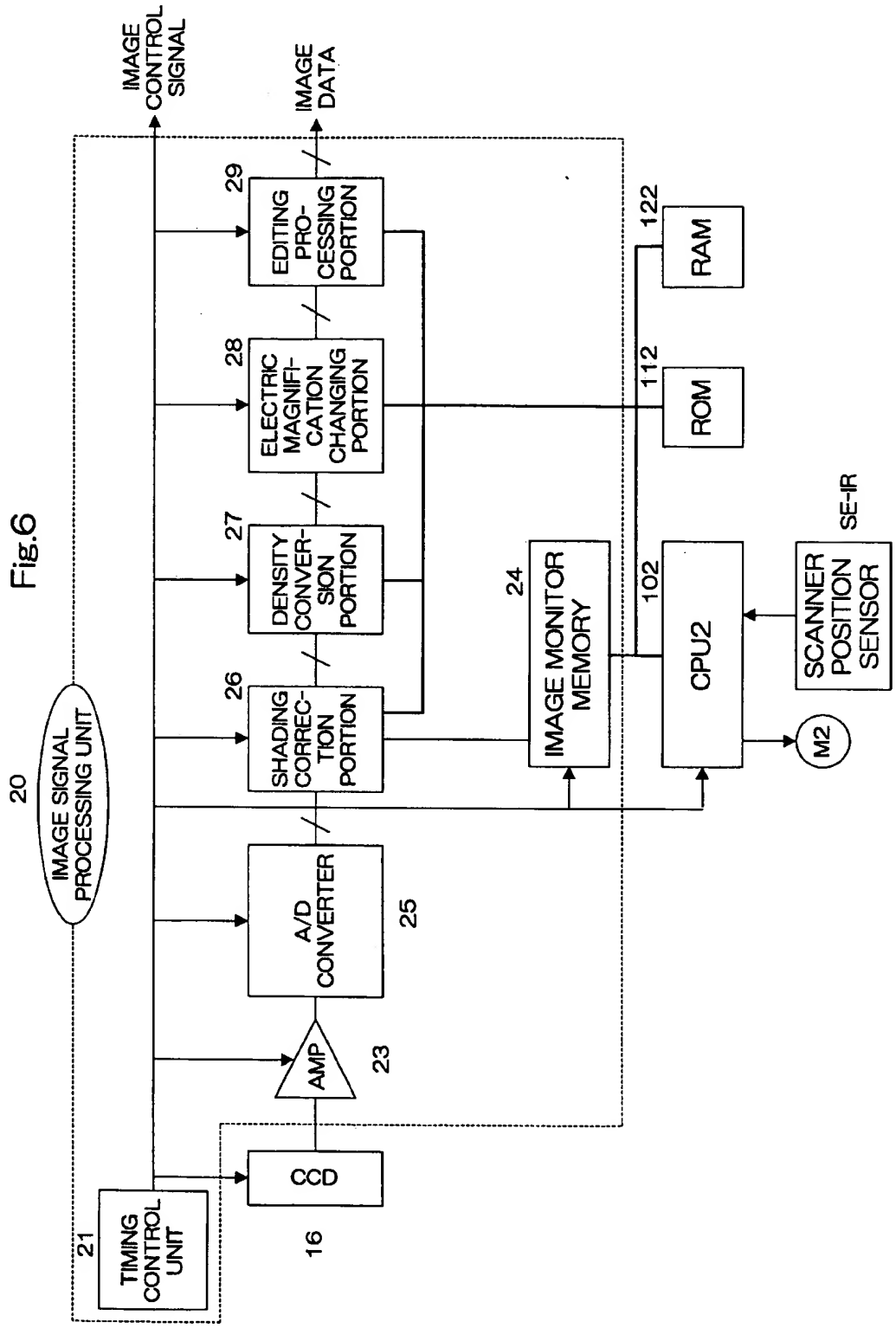


IMAGE CONTROL SIGNAL
IMAGE DATA
29
EDITING PRO-CESSING PORTION
28
ELECTRIC MAGNIFI-CATION CHANGING PORTION
27
DENSITY CONVER-SION PORTION
26
SHADING CORREC-TION PORTION
122
RAM
112
ROM
24
IMAGE MONITOR MEMORY
102
CPU2
SE-IR
SCANNER POSITION SENSOR
M2
20
IMAGE SIGNAL PROCESSING UNIT
A/D CONVERTER
25
AMP
23
CCD
16
21
TIMING CONTROL UNIT

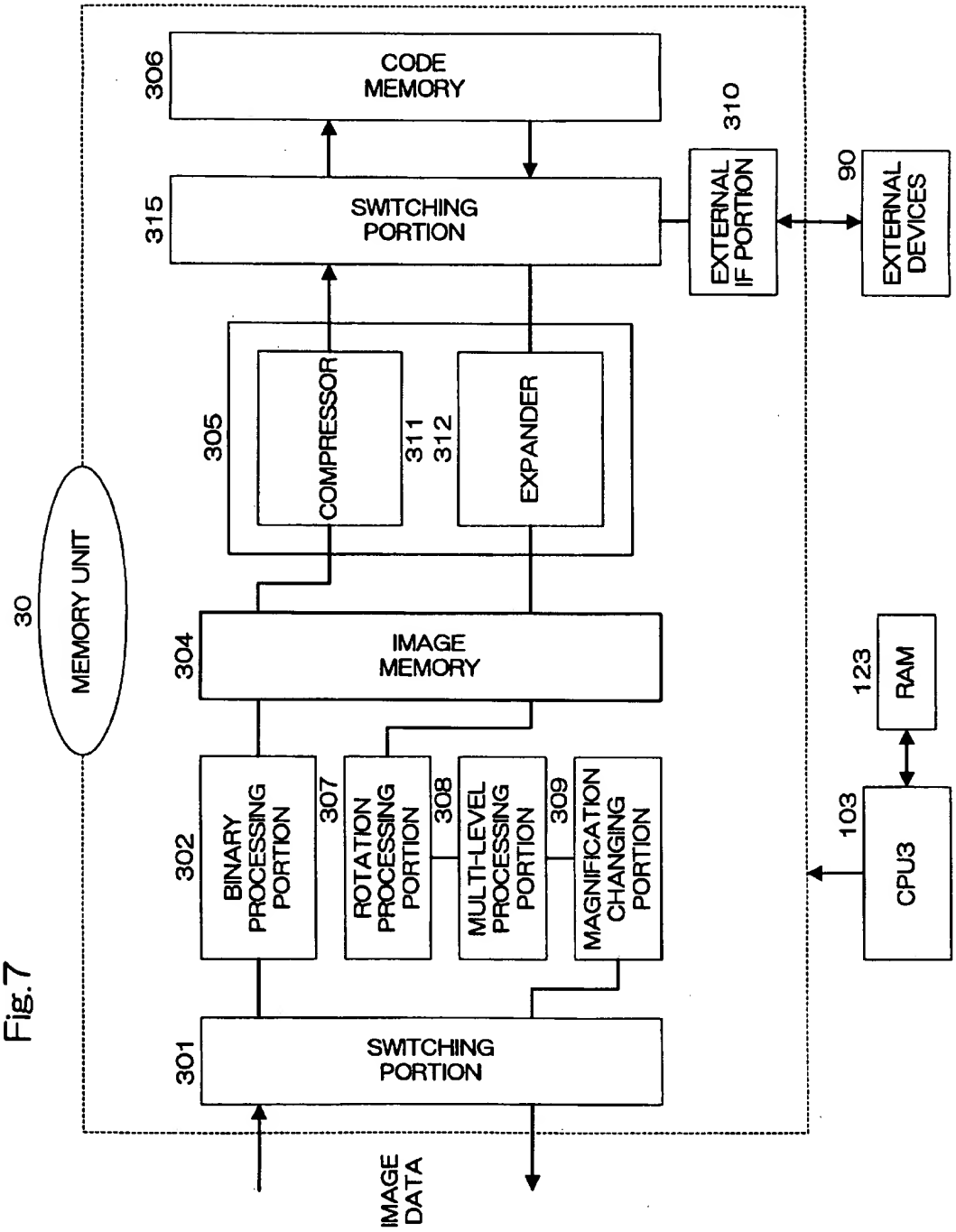

306
CODE MEMORY
310
315
SWITCHING PORTION
EXTERNAL IF PORTION
90
EXTERNAL DEVICES
305
COMPRESSOR
311
312
EXPANDER
30
MEMORY UNIT
304
IMAGE MEMORY
123
RAM
302
BINARY PROCESSING PORTION
307
ROTATION PROCESSING PORTION
308
MULTI-LEVEL PROCESSING PORTION
309
MAGNIFICATION CHANGING PORTION
103
CPU3
301
SWITCHING PORTION
IMAGE DATA

Fig.7

Fig.8(a)

MT1

REGION	PAGE NUMBER PN	FRONT LINK	BACK LINK	ADDITIONAL INFORMATION
00	1	00	01	
01	1	01	FF	
02	2	00	03	
03	2	03	FF	
⋮				

Fig.8(b)

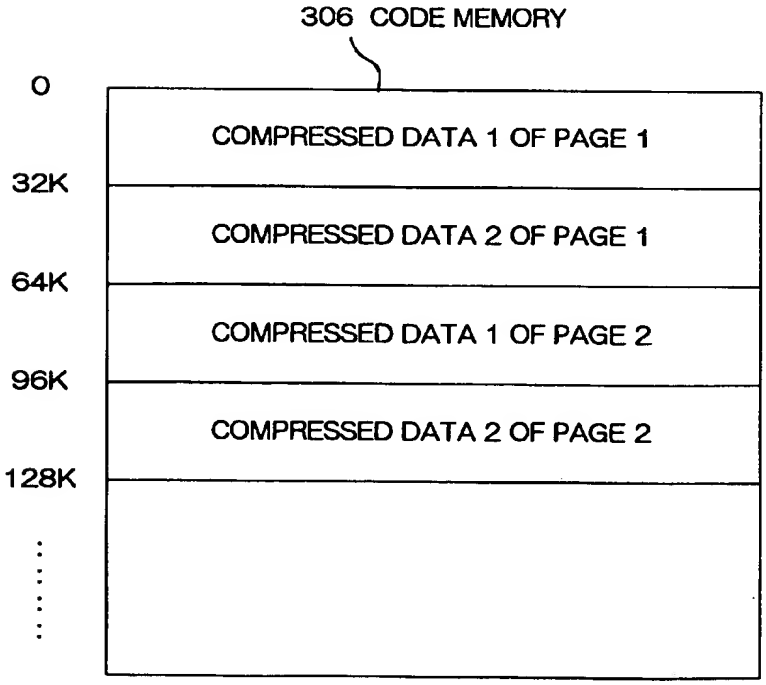


Fig.9

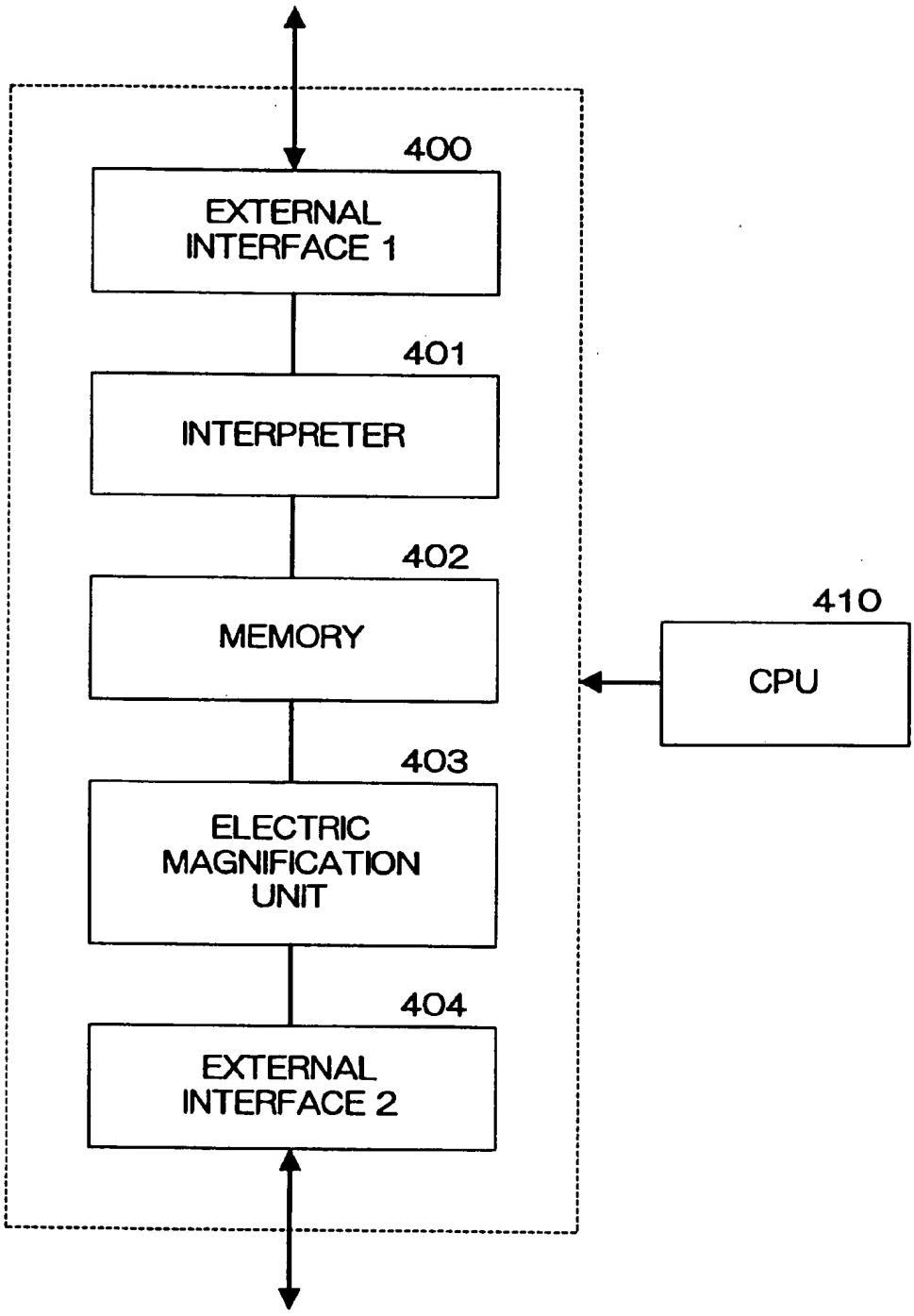

400
EXTERNAL INTERFACE 1
401
INTERPRETER
402
MEMORY
410
CPU
403
ELECTRIC MAGNIFICATION UNIT
404
EXTERNAL INTERFACE 2

Fig.10

MEMORY RECORDING OPERATION

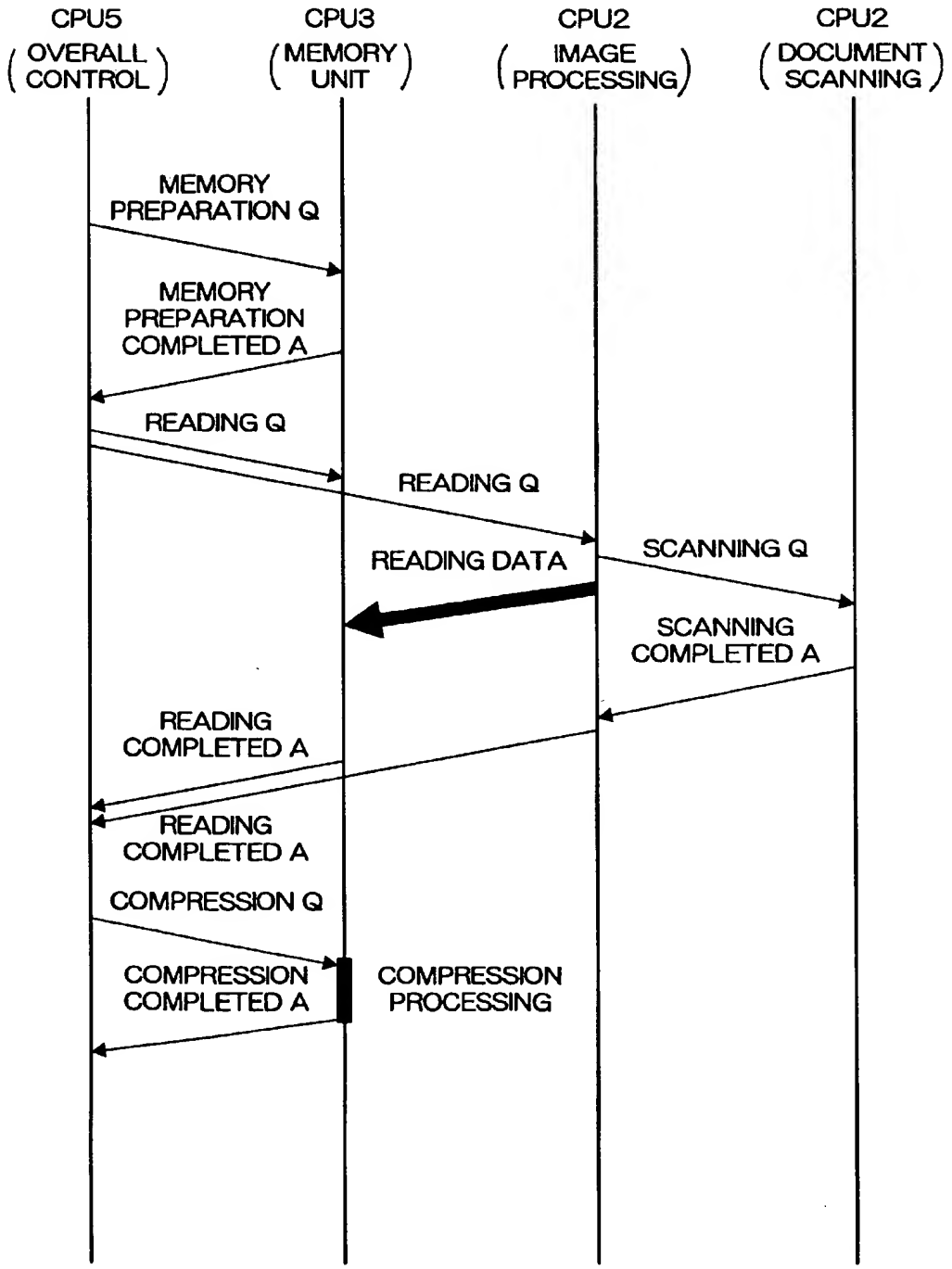


Fig.11

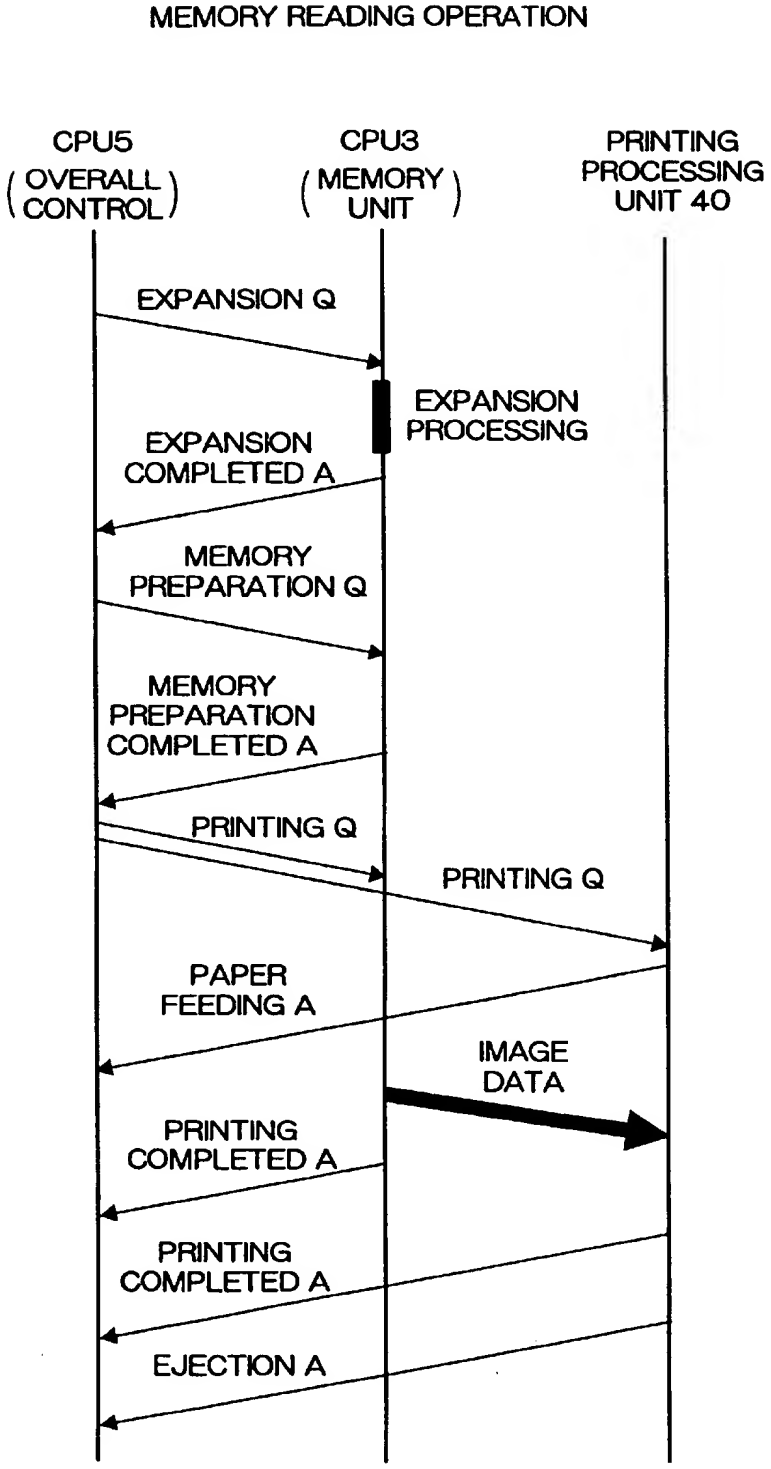

MEMORY READING OPERATION
CPU5
(OVERALL CONTROL)
CPU3
(MEMORY UNIT)
PRINTING PROCESSING UNIT 40
EXPANSION Q
EXPANSION PROCESSING
EXPANSION COMPLETED A
MEMORY PREPARATION Q
MEMORY PREPARATION COMPLETED A
PRINTING Q
PRINTING Q
PAPER FEEDING A
IMAGE DATA
PRINTING COMPLETED A
PRINTING COMPLETED A
EJECTION A

Fig.12

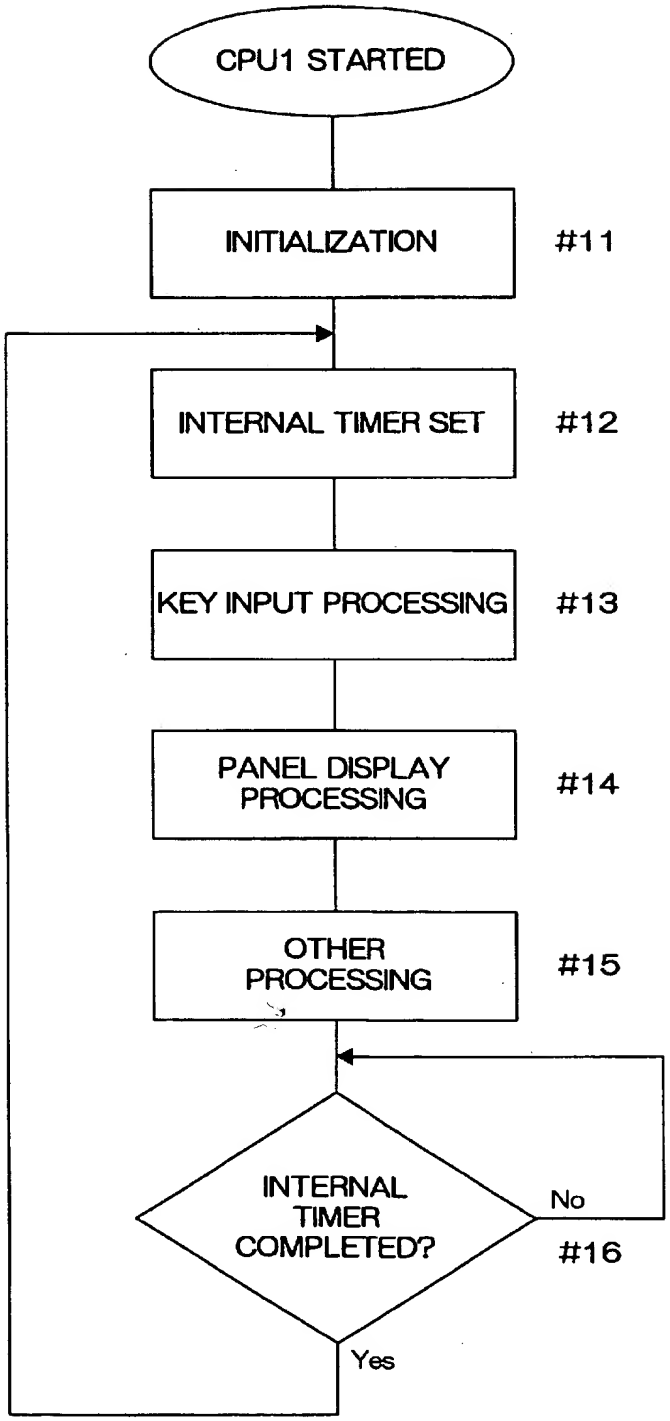

CPU1 STARTED
INITIALIZATION
#11
INTERNAL TIMER SET
#12
KEY INPUT PROCESSING
#13
PANEL DISPLAY PROCESSING
#14
OTHER PROCESSING
#15
INTERNAL TIMER COMPLETED?
No
#16
Yes

Fig.13

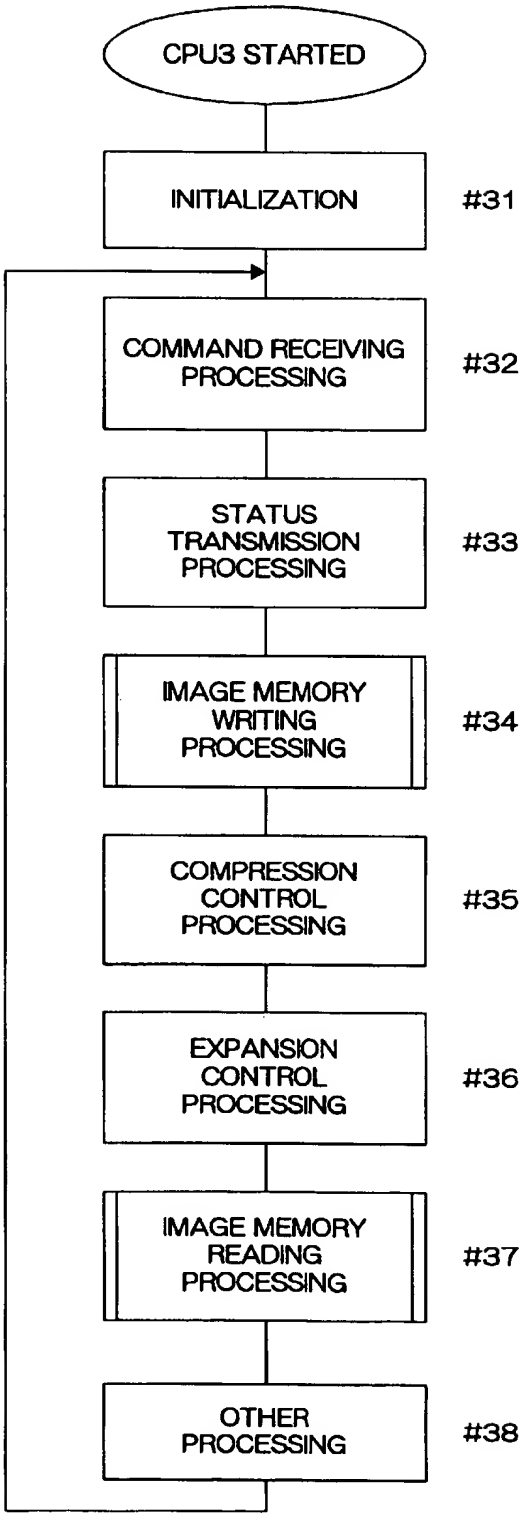

CPU3 STARTED
INITIALIZATION
#31
COMMAND RECEIVING PROCESSING
#32
STATUS TRANSMISSION PROCESSING
#33
IMAGE MEMORY WRITING PROCESSING
#34
COMPRESSION CONTROL PROCESSING
#35
EXPANSION CONTROL PROCESSING
#36
IMAGE MEMORY READING PROCESSING
#37
OTHER PROCESSING
#38

Fig.14

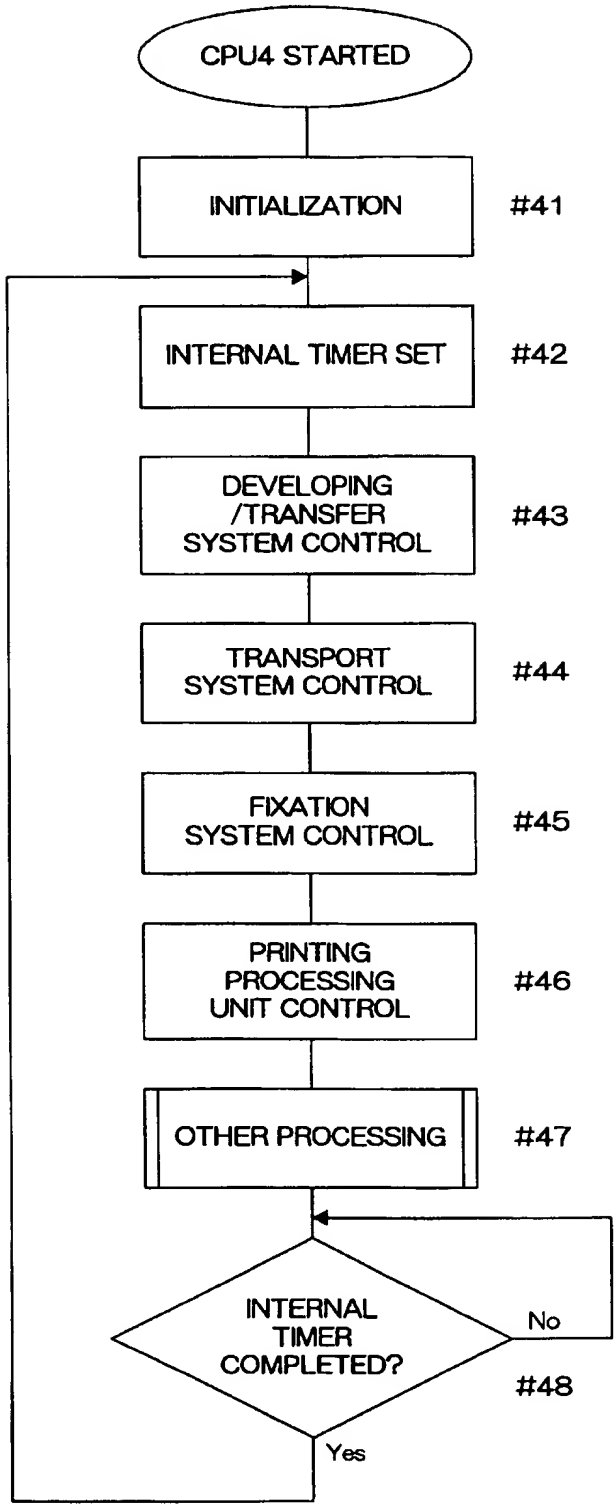

CPU4 STARTED
INITIALIZATION
#41
INTERNAL TIMER SET
#42
DEVELOPING /TRANSFER SYSTEM CONTROL
#43
TRANSPORT SYSTEM CONTROL
#44
FIXATION SYSTEM CONTROL
#45
PRINTING PROCESSING UNIT CONTROL
#46
OTHER PROCESSING
#47
INTERNAL TIMER COMPLETED?
No
#48
Yes

Fig.15

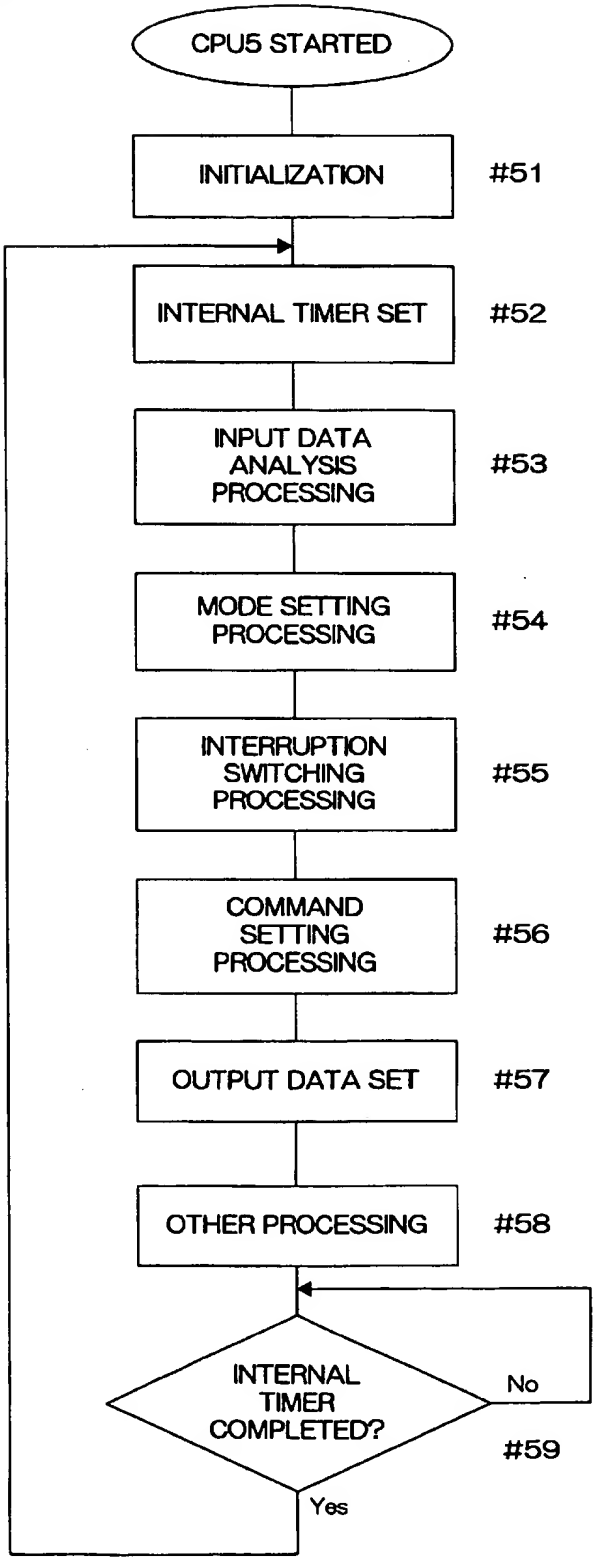

CPU5 STARTED
INITIALIZATION
#51
INTERNAL TIMER SET
#52
INPUT DATA ANALYSIS PROCESSING
#53
MODE SETTING PROCESSING
#54
INTERRUPTION SWITCHING PROCESSING
#55
COMMAND SETTING PROCESSING
#56
OUTPUT DATA SET
#57
OTHER PROCESSING
#58
INTERNAL TIMER COMPLETED?
No
#59
Yes

Fig.16

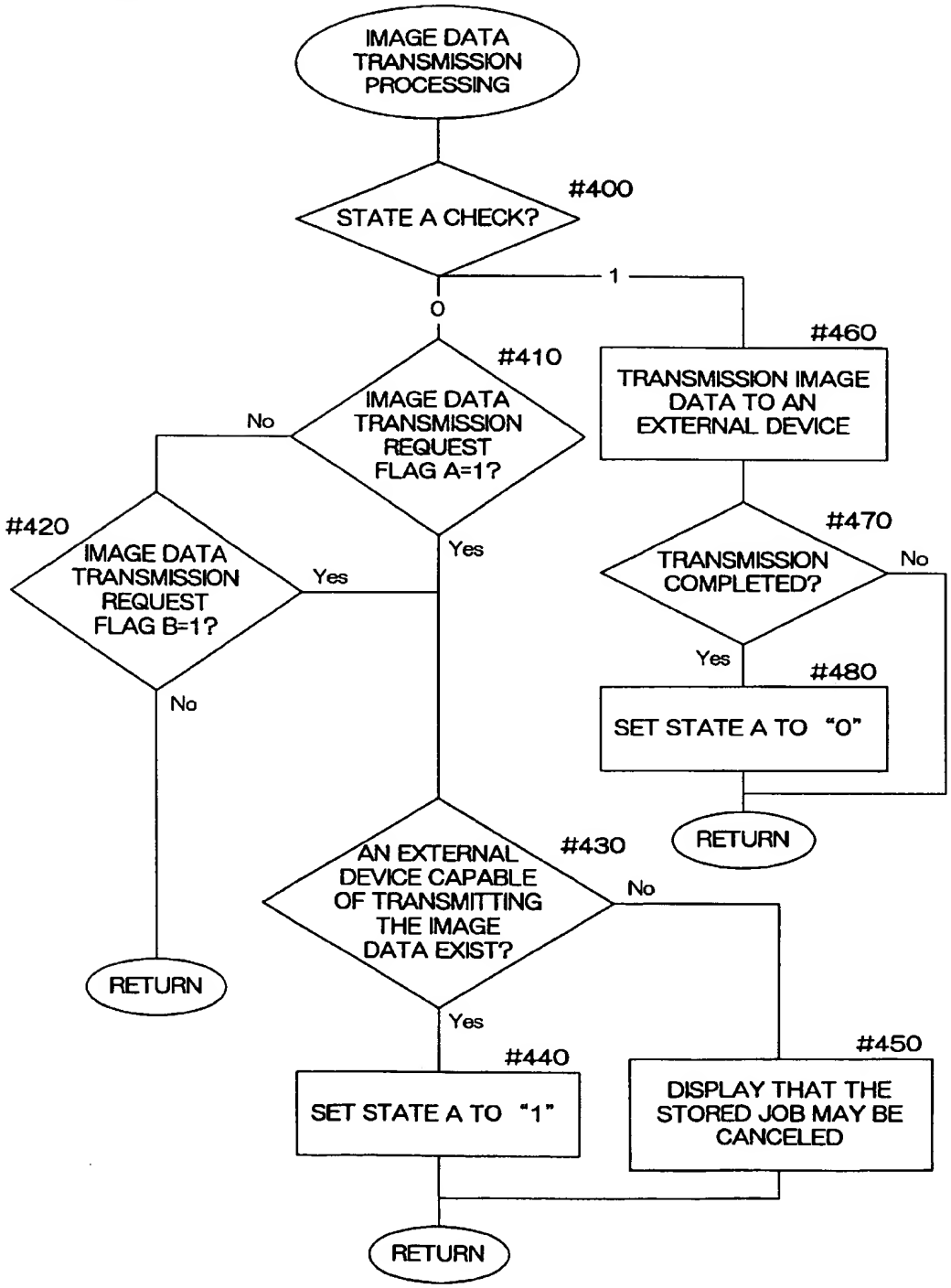


IMAGE DATA TRANSMISSION PROCESSING
#400
STATE A CHECK?
1
0
#460
TRANSMISSION IMAGE DATA TO AN EXTERNAL DEVICE
#410
IMAGE DATA TRANSMISSION REQUEST FLAG A=1?
No
Yes
#420
IMAGE DATA TRANSMISSION REQUEST FLAG B=1?
Yes
No
#470
TRANSMISSION COMPLETED?
No
Yes
#480
SET STATE A TO "0"
RETURN
#430
AN EXTERNAL DEVICE CAPABLE OF TRANSMITTING THE IMAGE DATA EXIST?
No
Yes
RETURN
#440
SET STATE A TO "1"
#450
DISPLAY THAT THE STORED JOB MAY BE CANCELED
RETURN

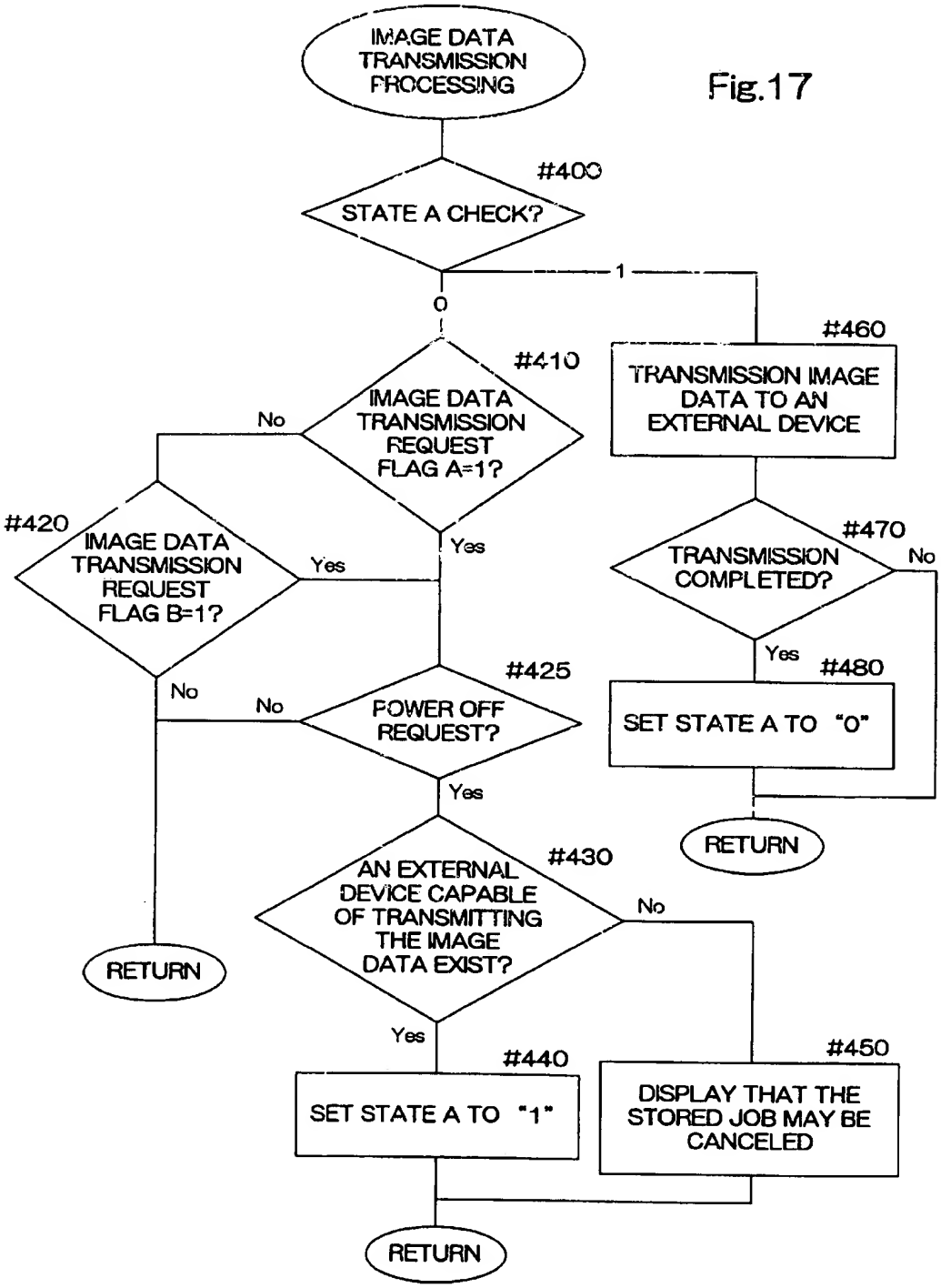


IMAGE DATA TRANSMISSION PROCESSING
#400
STATE A CHECK?
1
0
#460
TRANSMISSION IMAGE DATA TO AN EXTERNAL DEVICE
#410
IMAGE DATA TRANSMISSION REQUEST FLAG A=1?
No
Yes
#420
IMAGE DATA TRANSMISSION REQUEST FLAG B=1?
Yes
#470
TRANSMISSION COMPLETED?
No
Yes
#480
SET STATE A TO "0"
No
#425
POWER OFF REQUEST?
No
Yes
RETURN
#430
AN EXTERNAL DEVICE CAPABLE OF TRANSMITTING THE IMAGE DATA EXIST?
No
Yes
RETURN
#440
SET STATE A TO "1"
#450
DISPLAY THAT THE STORED JOB MAY BE CANCELED
RETURN

Fig.17

Fig.18

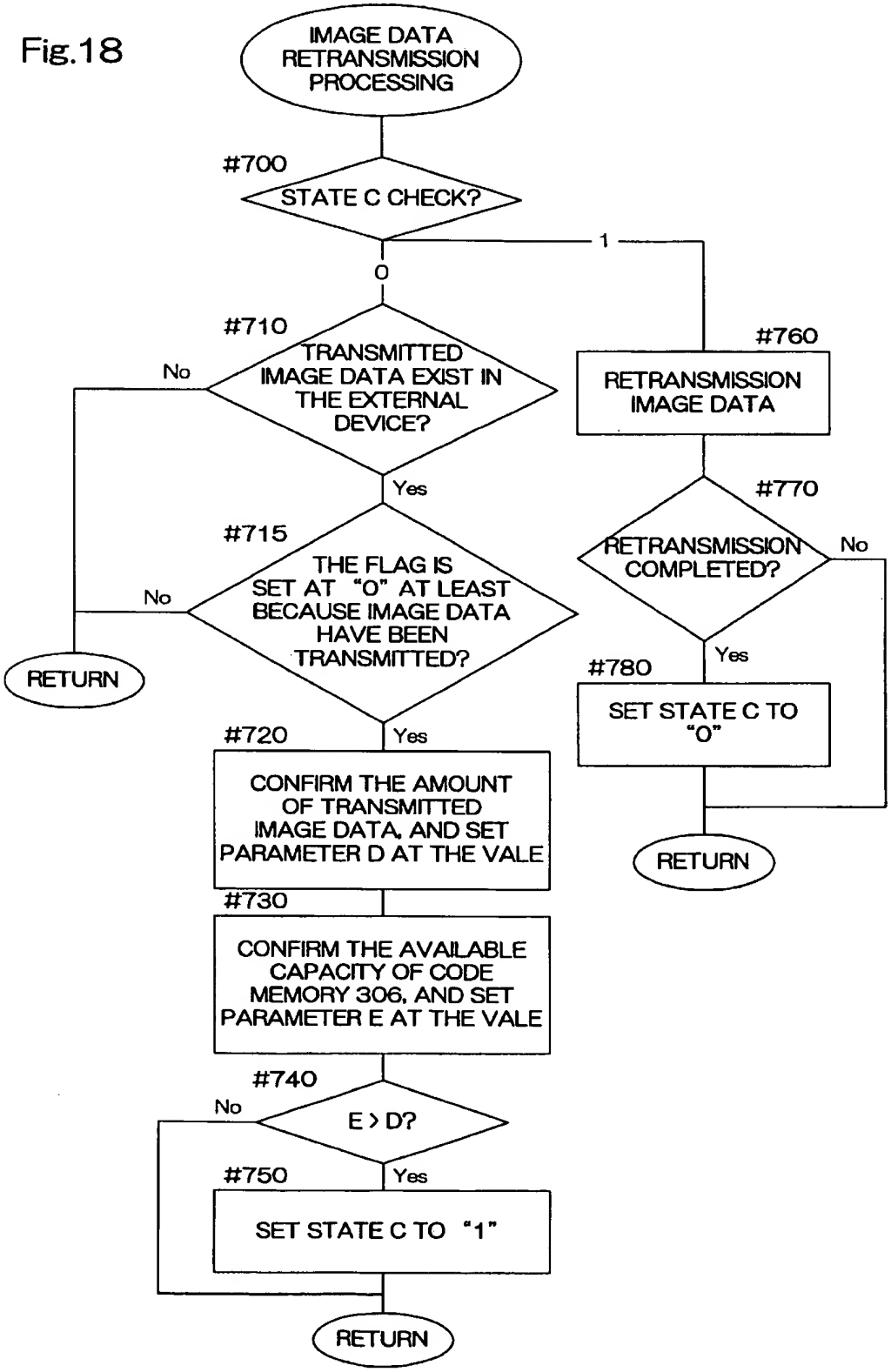


IMAGE DATA RETRANSMISSION PROCESSING
#700
STATE C CHECK?
0
1
#710
TRANSMITTED IMAGE DATA EXIST IN THE EXTERNAL DEVICE?
No
Yes
#715
THE FLAG IS SET AT "0" AT LEAST BECAUSE IMAGE DATA HAVE BEEN TRANSMITTED?
No
RETURN
#720
Yes
CONFIRM THE AMOUNT OF TRANSMITTED IMAGE DATA, AND SET PARAMETER D AT THE VALE
#730
CONFIRM THE AVAILABLE CAPACITY OF CODE MEMORY 306, AND SET PARAMETER E AT THE VALE
#740
No
E > D?
#750
Yes
SET STATE C TO "1"
RETURN
#760
RETRANSMISSION IMAGE DATA
#770
RETRANSMISSION COMPLETED?
No
Yes
#780
SET STATE C TO "0"
RETURN

Fig.19

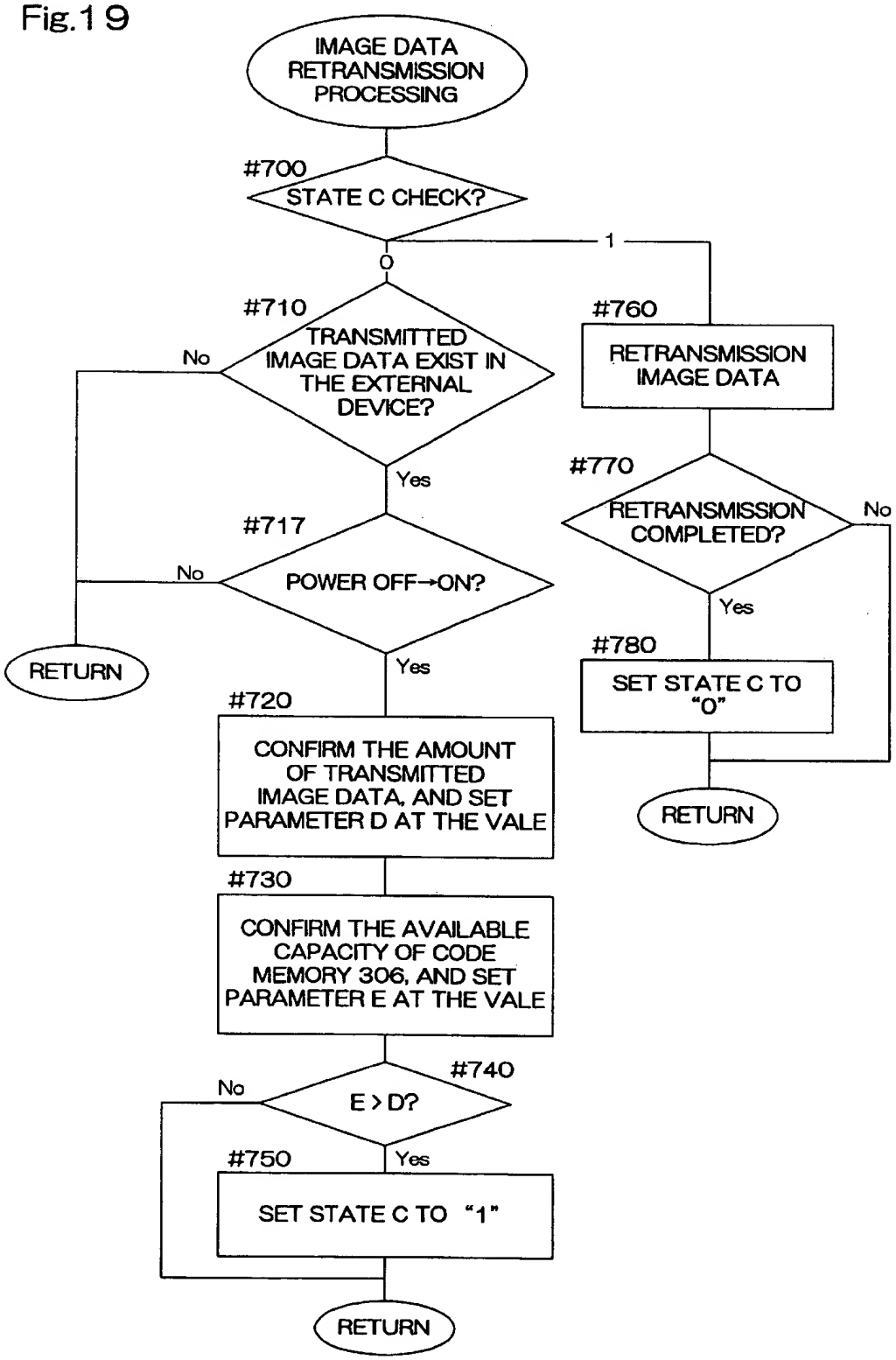


IMAGE DATA RETRANSMISSION PROCESSING
#700
STATE C CHECK?
0
1
#710
TRANSMITTED IMAGE DATA EXIST IN THE EXTERNAL DEVICE?
No
Yes
#717
POWER OFF→ON?
No
Yes
RETURN
#720
CONFIRM THE AMOUNT OF TRANSMITTED IMAGE DATA, AND SET PARAMETER D AT THE VALE
#730
CONFIRM THE AVAILABLE CAPACITY OF CODE MEMORY 306, AND SET PARAMETER E AT THE VALE
#740
E > D?
No
Yes
#750
SET STATE C TO "1"
RETURN
#760
RETRANSMISSION IMAGE DATA
#770
RETRANSMISSION COMPLETED?
No
Yes
#780
SET STATE C TO "0"
RETURN

Fig.20

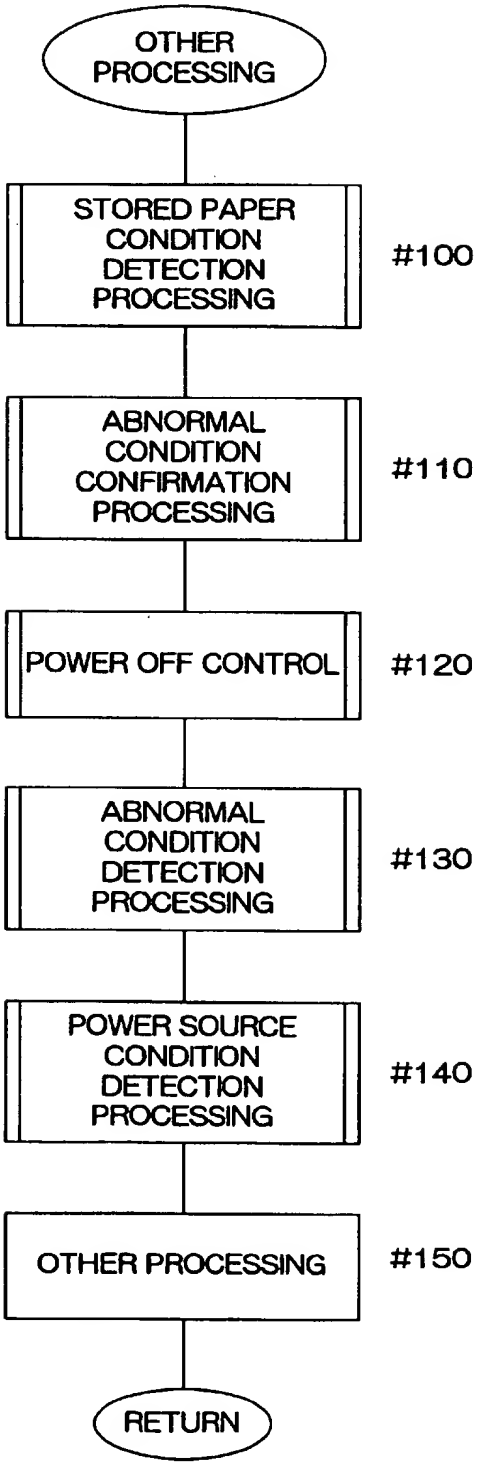

OTHER PROCESSING
STORED PAPER CONDITION DETECTION PROCESSING
#100
ABNORMAL CONDITION CONFIRMATION PROCESSING
#110
POWER OFF CONTROL
#120
ABNORMAL CONDITION DETECTION PROCESSING
#130
POWER SOURCE CONDITION DETECTION PROCESSING
#140
OTHER PROCESSING
#150
RETURN

Fig.21

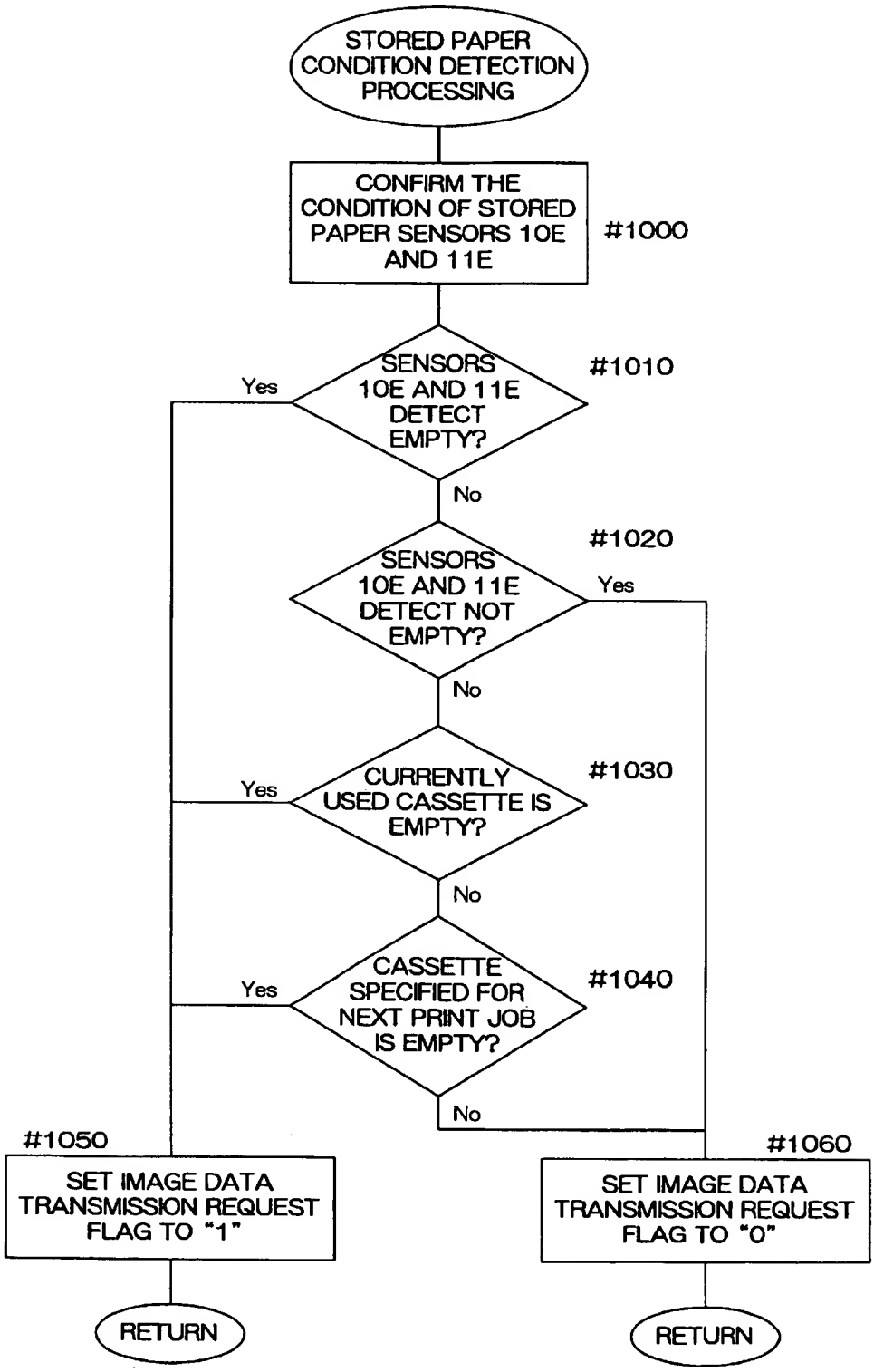

STORED PAPER CONDITION DETECTION PROCESSING
CONFIRM THE CONDITION OF STORED PAPER SENSORS 10E AND 11E
#1000
SENSORS 10E AND 11E DETECT EMPTY?
#1010
Yes
No
SENSORS 10E AND 11E DETECT NOT EMPTY?
#1020
Yes
No
CURRENTLY USED CASSETTE IS EMPTY?
#1030
Yes
No
CASSETTE SPECIFIED FOR NEXT PRINT JOB IS EMPTY?
#1040
Yes
No
#1050
SET IMAGE DATA TRANSMISSION REQUEST FLAG TO "1"
#1060
SET IMAGE DATA TRANSMISSION REQUEST FLAG TO "0"
RETURN
RETURN

Fig.22

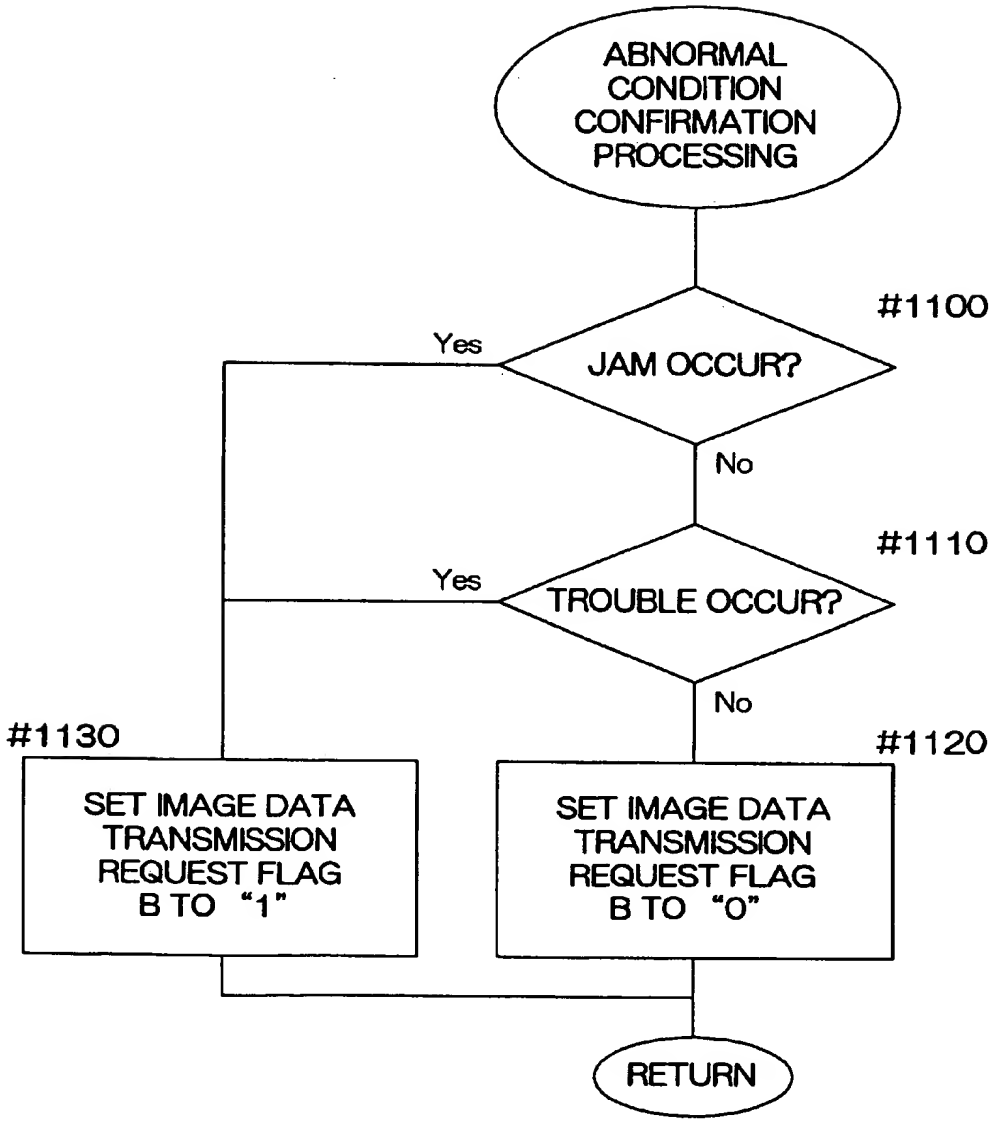

ABNORMAL CONDITION CONFIRMATION PROCESSING
#1100
JAM OCCUR?
Yes
No
#1110
TROUBLE OCCUR?
Yes
No
#1130
SET IMAGE DATA TRANSMISSION REQUEST FLAG B TO "1"
#1120
SET IMAGE DATA TRANSMISSION REQUEST FLAG B TO "0"
RETURN

Fig.23

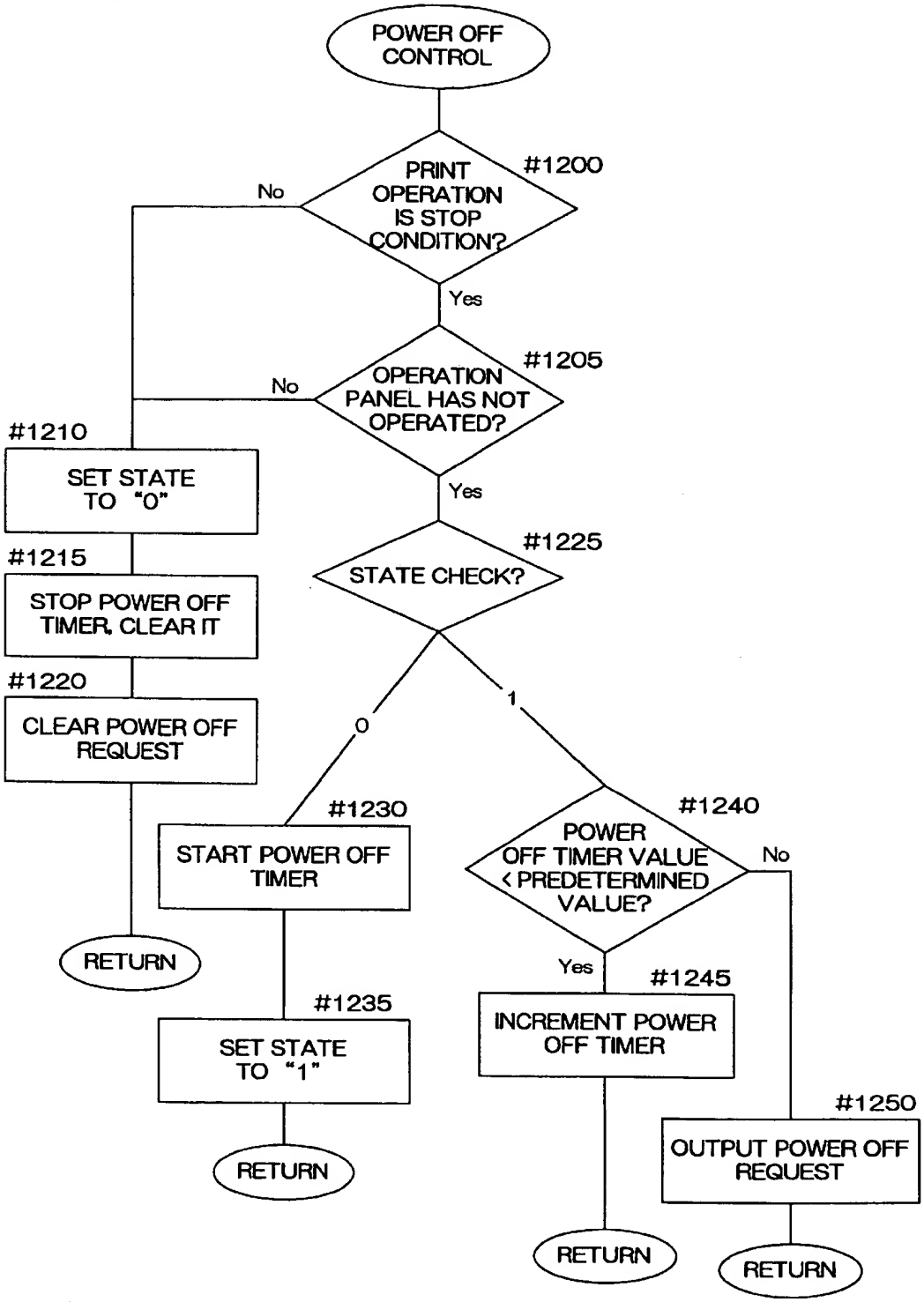

POWER OFF CONTROL
#1200
PRINT OPERATION IS STOP CONDITION?
No
Yes
#1205
OPERATION PANEL HAS NOT OPERATED?
No
Yes
#1210
SET STATE TO "0"
#1215
STOP POWER OFF TIMER, CLEAR IT
#1220
CLEAR POWER OFF REQUEST
#1225
STATE CHECK?
0
1
#1230
START POWER OFF TIMER
#1235
SET STATE TO "1"
RETURN
RETURN
#1240
POWER OFF TIMER VALUE < PREDETERMINED VALUE?
No
Yes
#1245
INCREMENT POWER OFF TIMER
#1250
OUTPUT POWER OFF REQUEST
RETURN
RETURN

IMAGE FORMING APPARATUS CAPABLE OF CONTINUOUS OPERATION AFTER MALFUNCTION CORRECTION

This application is based on Application No. HEI 9-195332 filed in Japan, the content of which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an image forming apparatus such as a digital copier, facsimile, printer, and combinations thereof, and specifically relates to an image forming apparatus connected to an external device such as another image forming apparatus, computer or the like via a communications network.

2. Description of the Related Art

In recent years image forming apparatuses have appeared which are capable of continuously and sequentially printing image data stored in installed memory having relatively large capacity. Such image forming apparatuses are advantageous in reducing the overall processing time and increasing operation efficiency of the apparatus because a plurality of jobs stored in memory can be consecutively processed.

Specifically, in the digital copier provided with an image reader disclosed in Japanese Laid-Open Patent Application NO. HEI 4-306059, an operator can start a reading operation regardless of an on-going printing operation so as to reduce the waiting time in front of the copier by independently controlling the printing operation for stored image data as well as the reading operation of a plurality of documents.

This type of image forming apparatus reduces the waiting time of an operator, and operators frequently leave the apparatus.

In conventional image forming apparatuses, a printing operation is temporarily stopped when the paper cassette being used becomes depleted, when a paper jam occurs in the transport path, and when other abnormalities occurs such as the fixing heater is shut off, inadequate charging and the like.

From the perspective of recent international environmental regulations, it has become standard to provide a function to turn OFF the power supply automatically when a predetermined time has elapsed after the apparatus has stopped.

As described above, in image forming apparatuses provided with memory, an image is held in memory while the apparatus is stopped when an abnormality occurs such as depletion of the paper in a cassette. At this time, the operator is frequently absent from the apparatus for the previously described reasons, and when the apparatus has remained in this state for a predetermined time, the automatic power cut off function is activated. Normally, conventional image forming apparatuses are not provided with backup power supplies to achieve a more compact form factor for the apparatus and reduce the cost of the power supply and the like, such that the stored image data are erased when the power supply is turned OFF, and, disadvantageously, the image must be input again performing an image reading operation when power is restored.

The power supply is also shut OFF for safety reasons when correcting abnormalities such as clearing a paper jam and the like when the apparatus has stopped due to an abnormality as previously described. In such instances, image data stored in memory are erased causing a similar disadvantage.

SUMMARY OF THE INVENTION

An object of the present invention is to eliminate the previously described disadvantages by providing an image forming apparatus capable of executing continuous printing operations automatically without special procedures when the stopped state of the apparatus is released.

One aspect of the present invention is to provide, in an image forming apparatus, a memory means for storing input image data, image forming means for forming an image on a recording medium based on said stored image data, communication means for transmitting and receiving image data to/from an external device, detection means for detecting trouble relating to said recording medium, and a control means to transmit said image data to said external device via said communications means when trouble is detected by said detection means and to receive transmitted image data via said communications means after said trouble has been cleared.

Another aspect of the present invention is to provide, in an image forming apparatus, a memory means for storing input image data, image forming means for forming an image on a recording medium based on said stored image data, communication means for transmitting and receiving image data to/from an external device, power source condition detection means for detecting the ON/OFF condition of the power source, detection means for detecting trouble relating to said recording medium, and a control means to transmit said image data to said external device via said communications means when trouble is detected by said detection means and to receive transmitted image data via said communications means when a change in the power source from an OFF condition to an ON condition is detected by said power source condition detection means.

A further aspect of the present invention is to provide, in an image forming apparatus, a memory means for storing input image data, image forming means for forming an image by operating a plurality of image forming elements, communication means for transmitting and receiving image data to/from an external device, detection means for detecting trouble relating to at least one among said plurality of image forming elements, and a control means to transmit said image data to said external device via said communications means when trouble is detected by said detection means and to receive transmitted image data via said communications means after said trouble has been cleared.

Another aspect of the present invention is to provide, in an image forming apparatus, a memory means for storing input image data, communication means for transmitting and receiving image data to/from an external device, power source condition detection means for detecting the ON/OFF condition of a power source, detection means for detecting trouble relating to said apparatus, and a control means to transmit said image data to said external device via said communications means when trouble is detected by said detection means and to receive transmitted image data via said communications means when a change in the power source from an OFF condition to an ON condition is detected by said power source condition detection means.

Embodiments of the aforesaid aspects include, in the transmission of said image data to an external device, determination of the presence/absence of a communications-enabled external device, and determination of whether or not the available memory storage capacity can receive the amount of transmitted image data. Unnecessary transmission and reception are therefore avoided.

Embodiments of the aforesaid aspects further include, transmission of image data when there has been a lack of

operation a predetermined time after detection of trouble. The disadvantage of erasure of image data is therefore avoided even when the power source has been turned OFF due to a lack of operation for a predetermined time.

These and other objects, advantages and features of the invention will become apparent from the following description thereof taken in conjunction with the accompanying drawings which illustrate specific embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following description. like parts are designated by like reference numbers throughout the several drawings.

FIG. **1** is a section view showing the general construction of a digital copier of an embodiment of the present invention;

FIG. **2** shows the operation panel of the digital copier of FIG. **1**;

FIG. **3** illustrates an example of a system connecting the digital copier of FIG. **1** and an external devices via a network circuit;

FIG. **4** is a circuit block diagram showing the general construction of the control unit of the digital copier of FIG. **1**;

FIG. **5** is a circuit block diagram showing the general construction of the control unit of the digital copier of FIG. **1**;

FIG. **6** is a control block diagram of reading unit **2** and image signal processing unit **20**;

FIG. **7** is a control block diagram of the memory unit **30**;

FIG. **8** illustrates the relationship between the job management table MT1 and the code memory **306**;

FIG. **9** is a control block diagram of the controller **4** shown in FIG. **3**;

FIG. **10** briefly shows the sequence of the memory recording operation, i.e., the operation of scanning of a document and recording the read image data in memory;

FIG. **11** briefly shows the sequence of the memory reading operation, i.e., the operation of reading image data from memory and printing said read image data on a paper sheet;

FIG. **12** is a main flow chart for central processing unit (CPU) **101** which manages the control of the operation panel;

FIG. **13** is a main flow chart for CPU **3** which manages the control of memory unit **30**;

FIG. **14** is a main flow chart for CPU **4** which manages control of the printer unit **3**;

FIG. **15** is a main flow chart for CPU **5** which manages overall timing adjustment for the digital copier **1**;

FIG. **16** is a flow chart for the image data transmission process which is one subroutine in the image memory recording process of FIG. **13**;

FIG. **17** is a flow chart showing another example of an image data transmission process;

FIG. **18** is a flow chart of the image data retransmission process which is one subroutine in the image memory reading process of FIG. **13**;

FIG. **19** is a flow chart showing another example of an image data retransmission process;

FIG. **20** is a subroutine showing the content of other processes of the main flow chart of CPU **4**;

FIG. **21** is a subroutine of the accommodated paper detection process of FIG. **20**;

FIG. **22** is a subroutine of the abnormal condition confirmation process of FIG. **20**; and

FIG. **23** is a subroutine of the power source OFF control of FIG. **20**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **1** shows the general construction of a digital copier of an embodiment of the present invention. In FIG. **1**, copier **1** comprises a scanning unit **10** for reading a document and converting the read data to image signals, image signal processing unit **20** for processing the image signals transmitted from scanning unit **10**, memory unit **30** for storing image signals processed by image signal processing unit **20** and outputting image signals to the print processor **40**, print processor **40** for driving semiconductor laser **61** based on image signals transmitted from memory unit **30**, laser optical unit **60** for directing the laser beam emitted from semiconductor laser **61** to the photosensitive member **71**, image forming unit **70** for developing the latent image formed on photosensitive member **71** via the exposure of the laser beam and transferring and fixing said developed image on a paper sheet, the previously mentioned operation panel **800**, automatic document feeder **500** for feeding a document onto the document table one sheet at a time and inverting said document front-to-back as necessary, and sheet recirculating unit **600** for recirculating an inverted sheet.

Reading unit **2** comprises the aforesaid scanning unit **10** and image signal processing unit **20**, and the printer unit **3** comprises the aforesaid print processor **40**, laser optical unit **60**, and image forming unit **70**. Switch SW1 is used to supply power from the power source to the digital copier **1**.

Reading unit **2** reads a document placed on document table **19**, and generates image data corresponding to each pixel of the document image. A first scanner **11** provided with an exposure lamp **12** and first mirror **13***a*, and a second scanner **14** provided with second and third mirrors **13***b* and **13***c* move in the arrow b and b' directions (sub-scan direction) via a scanning motor M2. At this time, the light emitted by exposure lamp **12** is reflected by a document placed on document table **19**, and the reflected light is directed to line sensor **17** via mirrors **13***a*, **13***b*, and **13***c*. Line sensor **17** is provided with a plurality of photoelectric conversion elements arrayed perpendicular to the paper surface (main scan direction), and outputs in line units the image data corresponding to each pixel at a resolution of, for example, 400 dots-per-inch (dpi), based on the reflected light of the document, thereby producing image data of one document sheet via the sub-scan by first and second scanners **11** and **14**. A home position sensor SE3 detects the first scanner **11** at the home position.

Image data output from line sensor **17** is transmitted to memory unit **30** after processing by image signal processing unit **20**. Memory unit **30** compresses and temporarily stores the received image data, and expands and transmits the stored image data to print processor **40**. Editing processes such as image inversion and the like are executed as necessary at this time. Memory unit **30** is also provided with an external device interface described later, so as to allow connection to an external device via external device connector **90** and peripheral cable **91**.

Printer unit **3** is described hereinafter. Print processor **40** controls the laser optical unit **60** based on the image data received from memory unit **30**. Laser optical unit **60** is provided with a semiconductor laser **61** for emitting a laser beam modulated (ON/OFF) by print processor **40**, polygonal

mirror **62** for scanning the laser beam emitted by semiconductor laser **61** on the surface of photosensitive drum **47**, fθ lens **63**, and mirrors **64***a* and **64***b*.

Arranged around the periphery of rotatable photosensitive drum **71** in the direction of drum rotation are charger **72**, developing device **73**, transfer charger **74**, separation charger **75**, cleaner **76**, and eraser lamp **77**; a toner image is formed by a well known electrophotographic process, and transferred onto a paper sheet. On the other hand, a paper sheet is fed from cassette **81***a* or **81***b* via take-up roller **82***a* or **82***b*, and transported to the position of charger **74** via feed rollers **83***a*, **83***b*, and timing roller **84**. The copy sheet bearing a toner image transferred by transfer charger **74** is transported to the recirculation unit **600** via transport belt **85**, fixing device **86**, and discharge roller **87**. Each of the aforesaid rollers and photosensitive drum **71** are driven by a main motor M1.

In the vicinity of cassettes **81***a* and **81***b* are provided paper size sensors SE1 and SE2 for detecting the size of the sheets accommodates in each cassette, and out-of-paper sensors **10**E and **11**E for detecting the presence/absence of paper accommodated in each cassette (i.e., whether or not the cassette is empty).

Paper sensors are provided in the paper feed path for detecting the transport state and timing of the sheet, so as to detect abnormalities in the paper path such as a paper jam and the like via the detection of the state of said paper sensors. In FIG. **1**, paper sensor **10**P is provided anteriorly to the timing roller **84**, sensor **11**P is provided near transport belt **85**, and sensor **12**P is provided posteriorly to discharge roller **87**. The paper jam detection method itself is well known and is, therefore, not described in detail. Although the present embodiment employs an example of three paper sensors, it is to be understood that the present invention is not limited to this number inasmuch as the number of sensors provided may be increased or decreased in accordance with the desired degree of precision of said detection.

Automatic document feeder **500** is described hereinafter. Automatic document feeder **500** automatically feeds a document placed in document tray **510** one sheet at a time onto document table **19**, and ejects a document scanned by scanning unit **10** to document discharge tray **511**.

Specifically, a document comprising a single sheet or a plurality of sheets are placed in document feed tray **510** with the reading surface facing upward with the position of said document adjusted by a side regulating panel, and when operation starts, the bottom-most document of the stack is fed sequentially via feed roller **501**. At this time, the document is managed by auxiliary roller **502** and pad **503** and transported one sheet at a time by intermediate roller **504**, and the document transport timing is detected by registration sensor SE**51** and the document width is detected by document size sensor SE**53**, and thereafter skewing of the document is corrected by registration roller **505**.

The document is transported by transport belt **506**, and directly after the trailing edge of the document passes the document scale **512**, the transport belt **506** reverses direction slightly and stops. This action abuts the trailing edge of the document against the endface of document scale **512** and accurately stops the document at position on document table **19**. At this time, the next document is transported to registration roller **505** to reduce the transport time of said next document.

A document on the document table **19** is scanned by scanning unit **10**, and subsequently transported to the left in the drawing via transport belt **506**, the transport direction is changed by inversion roller **507**, and thereafter the document passes above switching hook **508** and is ejected to discharge tray **511** via discharge roller **509**.

In the case of duplex documents, a document which has been scanned on a first side is again placed at the reading position on document table **19** by changing the transport direction via inversion roller **507**, and switching the switching hook **508**. After the image of the second side of the document has been scanned, the document is ejected to discharge tray **511** as previously described.

The recirculation unit **600** is described hereinafter. When duplex copying has been specified, recirculation unit **600** temporarily accommodates a copy sheet ejected by discharge roller **87**, and again feeds the sheet into the printing unit **3** via a switchback, whereas in single side copying the copy sheet is ejected to discharge tray **621** as previously described.

In the case of duplex copying, a copy sheet ejected from discharge roller **87** is switched in transport direction by switching hook **601**, and transported via transport roller **602** to forward/reverse roller **603**. Thereafter, when the trailing edge of the copy sheet is detected by sheet sensor SE**61**, forward/reverse roller **603** reverse rotates and the copy sheet is returned into the printer unit **3**. The returned copy sheet is transported to timing roller **84** via transport rollers **88***a*, **88***b*, and **88***c*, and enters a standby state for transfer of the image on the second side. When a plurality of copy sheets are continuously fed, each sheet is transported to the recirculation unit **600** consecutively at predetermined intervals to prevent overall of the sheets. Accordingly, since the copy sheet transport path is constant, the number of copy sheets which can be accommodated in the circulation path formed by the recirculation unit **600** and the main transport path is dependent on the size of the copy sheets. A copy sheet jam is detected when the trailing edge or leading edge of a copy sheet is not detected for a specified time based on the detection result of sheet sensor SE**61**.

FIG. **2** shows operation panel **800** of the digital copier of FIG. **1**. Operation panel **800** is provided with a liquid crystal touch panel **801** for setting modes and displaying various conditions, ten key pad **802** for entering numerical conditions such as number of copies and magnification, clear key **803** for returning numerical conditions to default values, panel reset key **804** for copy mode initialization, stop key **805** for specifying the interruption of a copy operation, start key **806** for specifying the start of a copy operation, document specification key **807** for specifying single side document or duplex document, light-emitting diodes LED **807***a* and **807***b* for displaying the document type specified by the document specification key, copy mode selection key **808** for selecting single side copies or duplex copies, LED **808***a* and **808***b* for displaying the selected copy mode, scan start key **809** for starting scanning of a next document during printing of a document, scan stop key **810** for interrupting scanning of a document, and record key **811** for recording a single scanned page or plurality of scanned pages of a document to memory as one job.

Liquid crystal touch panel **801** displays various displays such as an out-of-paper display indicating the absence of copy sheets in the various cassettes, a paper jam display indicating a copy sheet jam, and a trouble display warning of an abnormal condition such as inadequate motor drive, shut off heater and the like.

The digital copier **1** of the present embodiment temporarily stores scanned image data in memory, and reads out and prints image data from memory. Accordingly, when

scanning of a first document batch has been completed, it is possible to scan a next document batch even during printing of a first job (document batch), and it is possible to store a plurality of complete jobs in memory. In this instance, scanning of a next document batch is started by pressing the scan start key **809**, and after scanning setting the copy mode and pressing the record key **811** to record the scanned data as a job.

Jobs stored in memory unit **30** are not limited to the previously described scanned documents inasmuch as image data may be transmitted from an external device such as a computer or the like. In this instance, image data of one sheet or a plurality of sheets are automatically recorded as a single job without operating the record key **811**.

FIG. **3** illustrates an example of a system connecting the digital copier **1** of FIG. **1** and external an device via a network circuit. Digital copier **1** is provided with an external device connector **90** linked to a single controller **4**, i.e., an external device, via an interface cable **91**. Controller **4** is a universal interface such as Ethernet or the like, connected to a digital copier **1'** provided with functions similar to digital copier **1** via controller **4'** and a computer **5** or the like.

Operation of this system, for example, transmits data generated by computer **5** to controller **4** based on print requests from computer **5**. Data such as postscript data or the like transmitted from computer **5** are converted to raster data by controller **4**. The converted raster data are stored in memory (minimum capacity of one page) in controller **4**, and transmitted to digital copier **1**. In digital copier **1**, the received image data are temporarily stored in memory unit **30**, and printing starts if there is not a currently executing printing job, whereas said image data are held in standby condition as a recorded job if a printing job is currently executing, and printing starts after completion of the printing of the prior job. Image data scanned by digital copier **1** may be transmitted to computer **5** or digital copier **1'**, and conversely, transmitted image data may be returned to digital copier **1**.

The construction of the system is not limited to the previously described system inasmuch as network printers, and image reading apparatuses may be connected as other connected devices. Furthermore, the system may employ facsimile machines and the like connected via modems and public telephone lines.

FIGS. **4** and **5** are circuit block diagrams showing the construction of control unit **100** of digital copier **1**. Control unit **100** mainly comprises seven separate central processing units (CPU), which provide general control while transmitting and receiving information between CPUs via serial I/O. CPU **1**~**7** (**101**~**107**) are provided with read only memories ROM **111**~**117** for storing various programs, and random access memories RAM **121**~**127** used as work areas for execution of the aforesaid programs.

CPU **1** (**101**) controls the operation panel **800**, and receives input of signals from the various keys through I/O **131**, and outputs display data for the various displays through I/O **141**.

CPU **2** (**102**) controls various image processing executed by image signal processing unit **20**, and controls the drive of the scanning unit **10**, and the lighting of exposure lamp **12**.

CPU **3** (**103**) is provided within memory unit **30**, and stores image data received from image signal processing unit **20** in image memory **304** (described later with reference to FIG. **7**), and reads out and transmits said data from memory to print processor **40**. CPU **3** (**103**) further transmits and receives image data and control data to/from external devices via the external device connector **90** connected to memory unit **30**.

CPU **4** (**104**) controls print processor **40**, laser optical unit **60**, and image forming unit **70**. Specifically, CPU **4** (**104**) controls ON/OFF modulation of the semiconductor laser **61** based on received image data in print processor **40**. CPU **4** (**104**) controls rotation of the polygonal mirror **62** in laser optical unit **60**. CPU **4** (**104**) controls the operation of various aspects of image formation based on various input information in image forming unit **70**. The drive of main motor **M1** and motor controller **155** are further controlled by signals from this CPU through I/O **144**.

CPU **4** (**104**) manages the various conditions of the printer unit **3**. Specifically, manages copy sheet size via detection data received from copy size sensors SE1 and SE2 via I/O **134**. Similarly, out-of-paper status is managed via detection data from out-of-paper sensors **10E** and **11E**. This CPU also manages paper jam conditions at the various sensor positions via detection data from paper sensors **10P**, **11P**, and **12P**.

CPU **5** (**105**) manages various data timing adjustment among the various CPUs, and operation mode settings.

CPU **6** (**106**) controls automatic document feeder **500** by managing detection data of various sensors provided in the transport document path via I/O **136**, and controlling the drive circuit for document transport through I/O **146**.

CPU **7** (**107**) controls recirculation unit **600**, by managing detection data from various sensors placed in the recirculation path through I/O **137**, and controlling the drive of various transport rollers to recirculate a sheet through I/O **147**.

Essential details of the control block are described below with reference to FIGS. **6**~**9**. This block has reference numbers in common with FIG. **4**.

FIG. **6** is a control block diagram of reading unit **2** and image signal processing unit **20**. First, an image reading synchronization signal is supplied to each block by timing control unit **21**. Charge-coupled device (CCD) **16** photoelectrically converts the reflected light of a document via photoelectric conversion elements within line sensor **17** (refer to FIG. **1**), and generates electric signals based on document information. The generated signals are amplified by AMP unit **23**, and converted to 8-bit digital signals by analog-to-digital (A/D) converter **25**. Thereafter, the converted signals are processed to eliminate distortion caused by the optical system and the CCD.

The corrected signals are subjected to processing to correct gradient characteristics by converting the reflection data to density data in density converter **27**. Thereafter, the data are subjected to electrical variable magnification processing in the main scan direction from magnification information set by the electrical magnification unit **28**. The processed signals are then subjected to an image editing process by editing unit **29**, and transmitted as image data to print processor **40** and memory unit **30**.

Image monitor memory **24** stores **1** line segments of image data specified by CPU **2** (**102**). The stored data are used as reference data in a shading correction process by the shading correction unit.

CPU **2** executes general control of the reading unit **2** such as setting parameters for image processing blocks **26**~**29**, scan control for driving scanning motor **M2**, and communications with CPU **5** (**105**).

Document size and document direction detection operations are controlled by CPU **2** (**102**). Determination as to

whether or not a read image is a document is accomplished using, for example, the difference in reflected light between a document and a document cover when a document cover is reflected in a mirror. Prescan controls are executed when CPU **2** (**102**, receives a document size detection request from CPU **5** (**105**). At this time, CPU **2** (**102**) monitors scanner position information from scanner position sensor SEIR, and moves scanner **11** in the sub-scan direction to detect the document size and placement direction from the read image data and monitor position information; this information is then transmitted to CPU **5** (**105**).

When reading a document, CPU **2** (**102**) controls the actuation of scanning motor M2 at a speed based on the set magnification information received from CPU **5** (**105**).

FIG. **7** is a control block diagram for memory unit **30**. Memory unit **30** comprises a switching unit **301** for switching image data input/output, binarization unit **302** for generating binary data based on parameters set by CPU **3** (**103**), multiport image memory **304** having a capacity of two A4-size pages at a resolution of 400 dpi, encoder **305** provided with a compressor **311** and expander **312** capable of operating independently, code memory **306** for storing compressed code data, external interface IF **310** for transmitting and receiving data with an external device connected to external device connector **90**, switching unit **315** for switching the image data route between code memory **306** and external IF **310**, rotation processing unit **307** for executing rotation processing of image data, multi-level converter **308** for generating multi-level data based on parameter settings received from CPU **3** (**103**), variable magnification unit **309** for accomplishing electrical variable magnification, and CPU **3** (**103**) for controlling the aforesaid general aspects of memory unit **30**.

Switching unit **315** is constructed so as to be capable of transmitting and receiving signals with an external device via external IF **310**, and processes transmitting and returning image data characteristics of the present invention is executed via this part of CPU **3** (**103**). Management of information for the previously described controls is executed in external IF **310** by CPU **3** (**103**).

When image data are recorded in image memory **304**, encoder **305** reads out and compresses said image data as code data and transmits the code data to code memory **306**. Code data are readout from code memory **306** and expanded via instruction from CPU **3** (**103**), and recorded in image memory **304**. Compressor **311** and expander **312** operate in parallel and with mutual independence. Data are transmitted between encoder **305** and code memory **306** via direct memory access (DMA).

When expanded image data are expanded into 1-page segments in image memory **304**, image data are transmitted to rotation processing unit **307** via instructions from CPU **3** (**103**), and the image is rotated as necessary. Then, image data are converted to multi-level data from binary data by multi-level processor **308**, subjected to electrical variable magnification in the main scan direction and sub-scan direction by variable magnification unit **309** via parameters received from CPU **3** (**103**), and output.

When temporarily storing the aforesaid document image in code memory **306**, the code memory **306** is managed by a management table MT1 provided within RAM **123** (refer to FIG. **4**). Management table MT1 is described in detail later.

The operation of code memory **306** in the present invention when digital copier **1** is not connected to a network and the memory of an external device cannot be used is such that the full capacity state of code memory **306** is detected, and a compression complete report is added to the parameters indicating further compression is disabled is sent from CPU **3** (**103**) to CPU **5** (**105**). This process alerts CPU **5** (**105**) to the memory full status of code memory **306**, other CPUs are alerted to the memory full status via communication with CPU **5** (**105**), and processing is executed based on this status. In the case of CPU **1** (**101**), for example, a trouble warning is displayed on the display area of operation panel **800**, and in the case of CPU **2** (**102**), an executing reading operation is interrupted.

When digital copier **1** is connected to a network so as to allow use of the memory of an external device, e.g., in a system such as illustrated in FIG. **3**, image data stored in code memory **306** are temporarily transmitted to the memory of an external device when an out-of-paper, paper jam or other abnormal state is generated in digital copier **1**. Thereafter, the image data are retransmitted from the memory of the external device and printing is resumed when the trouble state is corrected by replenishing the paper supply, restarting the power source, and removing the paper jam. The returned data are stored in code memory **306** through, for example, external IF **310** and switching unit **315**. These controls are executed by CPU **3** (**103**).

FIGS. **8***a* and **8***b* illustrate the relationship between the previously mentioned management table MT1 and code memory **306**. In consideration of simultaneous control of recording (during image reading) and readout (printing), code memory **306** is divided into memory areas of 32 kb units to store the compressed data (code data) of each page.

Management table MT1 stores numbers indicating the area of code memory **306**, page number PN attached document units in recorded sequence (document reading sequence), linking information previous and subsequent memory areas, and appended information, and dynamically manages code memory **306** based on said information. Appended information includes information required for the compression and expansion processes such as compression method and data length and the like, job record number for managing a document (images) of a single page or a plurality of consecutive pages as a single job, and operation mode information for each job such as number of pages to be printed and magnification and the like.

The column heading [front link] in management table MT1 indicates a link of each memory area in a forward direction; a front link of [00] indicates the initial area of image data of one page, and a front link other than [00] indicates an area linked to another area. The column heading [back link] similarly indicates a link of each memory area in a back direction; a back link of [FF] indicates the final area of image data of one page, and a back link other than [FF] indicates an area linked in a back direction.

When image data are readout and compressed from image memory **304**, CPU **3** (**103**) refers to management table MT1 and controls the compressor **311** and stores the compressed data in code memory **306**. When image data are output, CPU **3** (**103**) similarly refers to management table MT1 and controls expander **312** and reads out the image data from code memory **306**.

The information management table MT1 is erased after page information has been properly read out and the number of pages set by a user have been properly printed.

FIG. **9** is a control block diagram of controller **4** shown in FIG. **3**. In the drawing, reference number **400** refers to external interface **1** for sending and receiving data to/from computer **5**. Reference number **401** refers to an interpreter

for translating data (e.g., postscript data) transmitted from computer **5** and expanding said data to raster data. Image data expanded to raster data are sequentially stored in memory **402**. When 1 page segment image data stored in memory **402** are expanded, the image data are transmitted to digital copier **1** through electric magnification unit **403** and external interface **2** (**404**). At this time, electric variable magnification unit **403** controls the image data transmission speed by the electric variable magnification in the sub-scan direction (FD direction) based on magnification adjustment data (speed adjustment data) transmitted from the digital copier **1**. CPU **410** executes batch control of blocks **400**–**404**.

Controller **4** is capable of transmitting compressed image data directly from digital copier **1** to an external device or from an external device to digital copier **1** based on control data from digital copier **1** without executing a raster expansion operation on said image data.

The operation sequence of digital copier **1** is described below by focusing on the request commands (Q) and reports (A) and image data flow among the various CPUs.

FIG. **10** briefly shows the sequence of the memory recording operation, wherein a document is scanned and the read image data are stored in memory. In this operation, read image data are transmitted from image signal processing unit **20** to image memory **304** of memory unit **30**.

First, CPU **5** (**105**) which controls the overall sequence requests memory preparation by CPU **3** (**103**) (memory preparation Q). CPU **3** (**103**) receives this request, and sets the bus connection state of the hardware within memory unit **30** for transmitting image data from image signal processing unit **20** to image memory **304**, sets the mode of binarization, and sets the starting address of the recording area in image memory **304**, and the XY range for encoding.

When these settings are completed, CPU **3** (**103**) alerts CPU **5** (**105**) that preparation memory unit **30** is completed (memory preparation complete A). Then, CPU **5** (**105**) requests that CPU **2** (**102**) start reading (reading Q). When this request is received, CPU **2** (**102**) instructs its internal document scanning controller to start scanning (scan Q). When the document scanning controller starts scanning of the document and scanner **11** arrives at the image region, the image is read in accordance with the image processing mode set by CPU **2** (**102**), and the read image data are transmitted from image signal processing unit **20** to memory unit **30**.

When document scanning controller completes scanning (scan end A), CPU **2** (**102**) alerts CPU **5** (**105**) that reading has ended. Then, an alert indicating that reading has ended is sent from CPU **3** (**103**) (reading end A).

Then, CPU **5** (**105**) requests image data compression by CPU **3** (**103**) (compression Q). CPU **3** (**103**) receives this request, and sets the readout address in image memory **304**, XY range information, recording address in code memory **306**, mode for compressor **311** (e.g., arithmetic encoding method, modified Huffman (MH) method), and activates each block. In this way, image data compression processing is accomplished. When compression is completed, an alert indicating the end of compression is sent from CPU **3** (**103**) to CPU **5** (**105**) (compression end A), and the memory recording operation ends.

FIG. **11** briefly shows the sequence of the memory reading operation, i.e., reading image data from memory and printing the read image data on a copy sheet. In this operation, the code data stored in code memory **306** is read out by the aforesaid memory recording operation, and transmitted as expanded image data to the print processor **40** for printing.

CPU **5** (**105**) requests code data expansion from CPU **3** (**103**) (expansion Q). This request is received by CPU **3** (**103**), which sets the readout address in code memory **305**, data quantity, XY range information, record address in image memory **304**, and mode of expander **312** (e.g., arithmetic encoding method, modified Huffman (MH) method), and activates each block. In this way the code data expansion process is accomplished and image data are stored in image memory **306**. When the expansion process ends, an alert indicating that expansion is completed is sent from CPU **3** (**103**) to CPU **5** (**105**) (expansion end A).

When the expansion process ends, CPU **5** (**105**) sends a memory preparation request to CPU **3** (**103**) to read out image data from image memory **304** (memory preparation Q). CPU **3** (**103** receives this request, and sets the bus connection state in hardware within the memory unit **30** for transmission of image data from image memory **304** to print processor **40**, sets parameters for the rotation process, and sets the start address of the readout area in image memory **304**.

When these settings are completed, CPU **3** (**103**) alerts CPU **5** (**105**, that the preparation of memory unit **30** is completed (memory preparation end A). Then, CPU **5** (**105**) requests CPU **3** (**103**) to start printing by print processor **40** (print Q). CPU **3** (**103**) receives this request, and print processor **40** transmits a paper supply report indicating the copy paper condition to CPU **5** (**105**) (paper supply A), and subsequently image data read out from image memory **304** are transmitted to print processor **40** and printed.

When printing is completed, CPU **3** (**103**) and print processor **40** transmit print end reports to CPU **5** (**105**) (print end Q), and print processor **40** transmits an eject end report (eject A). CPU **5** (**105**) receives these reports, and sends a memory clear request to CPU **3** (**103**) as necessary.

The operation controls of the present embodiment are described below with reference to the flow charts of FIGS. **12**~**22**.

FIG. **12** is a main flow chart of CPU **1** (**101**) which controls the operation panel.

When the power source is turned ON, first, the RAM and registers are initialized (#11). Then, an internal timer is set to regulate the length of one routine (#12), and the key input process is executed to receive key operations (#13). Thereafter, the display data are set and displayed based on the input key information and status of the digital copier **1** (#14). In step #15, other processes are executed, and in step #16 the end of the internal timer is awaited, and the processes from step #12 are repeated. Interrupt processing is executed with suitable timing to communicate with other CPUs.

FIG. **13** is a main flow chart for CPU **3** (**103**) which controls memory unit **30**.

When the power source is turned ON, first the RAM and registers are initialized (#31). Then, the reception process is executed to receive commands from other CPUs (#32), and status signals indicating the state of CPU **3** (**103**) are transmitted to other CPUs (#33). In step #34, image data are recorded in image memory **304**, the image data of image memory are encoded and stored in code memory **306**. In this step, processing is also executed to transmit image data to an external device in accordance with conditions described later. The image data transmission process is described in detail later with reference to FIGS. **16** and **17**. In step #35, a compression control process is executed to encode image data transmitted from image memory **304**, and in step #36 an expansion control process is executed to convert code data

from code memory **306** to the original image data. In step **#37**, code data stored in code memory **306** are read out and expanded in image memory **304**, and image data are transmitted form image memory **304** to print processor **40**. In this step, processing is also executed to return image data from an external device in accordance with conditions described later. The image data return transmission process is described in detail later with reference to FIGS. **18** and **19**. In step **#38**, other processes are executed relating to memory unit **30**, and the processes from step **#32** are repeated.

FIG. **14** is a main flow chart for CPU **4** (**104**) which controls printer unit **3**.

When the power source is turned ON, first the RAM and registers are initialized (**#41**), then an internal timer is set to regulate the length of one routine (**#42**).

Thereafter, control of processes for developing and transfer are executed (**#43**), control of the transport system is executed for copy sheet feeding and document transport (**#44**), control of the fixing unit is executed for fixing temperature regulation and the like (**#45**), and control is executed for the print processor **40** for controlling emission of the laser diode (**#46**).

The contents of the controls of steps **#43**~**#46** are omitted from this description because they are well known in the art, but briefly, the paper jam detection is executed in step **#44**, and detection of abnormalities of the fixing heater such as heater shutoff are executed in step **#45**.

In step **#47**, other controls are executed for printer unit **3**, and in step **#48** the end of the internal timer is awaited, and the processes of step **#42**~**#48** are repeated. The other processes executed in step **#47** include a paper detection process to detect an out-of-paper condition, abnormal condition confirmation process, and power source ON process; among these processes, various information is transmitted to CPU **3** (**103**) such as power source OFF request, and image data transmission and retransmission requests based on various abnormal condition detection such as detection of a confirmed out-of-paper condition, paper jam detection and the like. Details of other processes (step **#47**) are described later with reference to FIGS. **20**~**23**.

FIG. **15** is a main flow chart for CPU **5** (**105**) which regulates the overall timing of the digital copier **1**.

When the power source is turned ON, first, the RAM and registers are initialized (**#51**), then, an internal timer is set to regulate the length of one routine (**#52**).

Then, an input data analysis process is executed to check data input from other CPUs (**#53**), a mode setting process is executed to set various operation modes in accordance with operation content (**#54**), interrupt switching process is executed for interrupt processes (**#55**), command setting process is executed for setting commands in accordance with the set modes (**#56**), and output data process is executed to await the set commands in communication reports (**#57**).

In step **#58**, other controls are executed by CPU (**105**), and in step **#59** the end of the internal timer is awaited, and the processes of steps **#52**~**#59** are repeated.

FIG. **16** is a flow chart showing the image data transmission process of one routine in the image memory recording process (**#34**) of FIG. **13**. FIG. **17** is a flow chart showing another example of a image data transmission process.

First, in step **#400**, a state A check is executed. state A is set at [0] during initialization, and the following process branches depending on the content of state A.

When state A is set at [0], a check is made in step **#410** to determine whether or not image data transmission request flag A is set at [1]. When flag A is set at [1], a check is made to determine whether or not an external device is able to transmit image data, i.e., whether or not image data can be stored in an external device connected to the network (**#430**). This determination is executed by means of a control command in the program executed by CPU **3** via external IF **310**. Image data transmission request flag A is set in the paper condition detection process of FIG. **21** described later, and is set at [1] during an out-of-paper condition.

In step **#410**, a determination is made as to whether or not the image data transmission request flag B is set at [1] when the image data transmission request flag A is set at [0]. When flag B is set at 1, a determination is made as to whether or not an external device is capable of transmitting data (**#430**). Image data transmission request flag B is set in the abnormal state confirmation process of FIG. **22** described later, and is set at [1] during a paper jam or abnormal state. When the image data transmission request flag B is set at [0] in step **#420**, this subroutine returns directly and the main routine ends.

When an external device is able to transmit data in step **#430**, state A is set at [1] in step **#440**, and this subroutine ends. When an external device able to transmit image data is not present in step **#430**, there is a possibility that the job recorded in code memory **306** may be disrupted because image data cannot be transmitted to an external device, and a warning is displayed on liquid crystal display **801** (**#450**), and this subroutine ends.

When state A is set at [1] in step **#400**, image data,are transmitted to an external device in step **#460**. The management table (FIG. **8**) is used in the transmission of image data at this time. For example, image data are transmitted with appended information such as job number information, page number information, job memory capacity and the like. When a plurality of jobs are recorded, said plurality of jobs are transmitted during standby. Then, a determination is made in step **#470** as to whether or not image data transmission is completed. When it is determined that data transmission has ended, state A is set at [0], and this subroutine ends, whereas when data transmission has not ended (**#470**: NO), this routine ends directly.

In this subroutine, image data are transmitted to an external device connected to the network when an abnormal state occurs such as an out-of-paper condition, paper jam state And the like via the determination of the image data transmission request flags A and B. In this way stored jobs are not erased unbeknownst to an operator when the power source is shut OFF in conjunction with auto power OFF function when operation does not resume a predetermined time during a print stoppage, or in conjunction with clearing a paper jam or other abnormal condition.

FIG. **17** is a flow chart showing another example of the image data transmission process. In the drawing, steps having numbers identical to those in FIG. **16** are identical and are not mentioned further.

In FIG. **17**, step **#425** is a newly added step. When it is determined that image data transmission request flags A and B are set at [1] in steps **#410** and **#420**, a determination is made in **#425** as to whether or not a power OFF request has been issued. When it is determined a power OFF request has been issued in step **#425**, the processes of step **#430** and subsequent steps are executed, whereas when it is determined that a power OFF request has not been issued, this subroutine ends directly. The power OFF request is a command set in the power OFF control subroutine (FIG. **23**) described later, and is output from CPU **4** when the opera-

tion panel has not been operated for a predetermined time during a print operation stoppage. In the subroutine of FIG. **17**, the aforesaid processes execute image data transmission to an external device connected to the network when operation has not resumed after a predetermined time following occurrence of an out-of-paper condition, paper jam, or other abnormal condition. These processes execute image data transmission only when there has been no operation for a predetermined time to prevent unnecessary transmissions to external devices.

FIG. **18** is a flow chart of the image data retransmission process of one subroutine in the image memory reading process (**#37**) of FIG. **13**. FIG. **19** is a flow chart showing another example of the image data retransmission process.

First, state C is checked in step **#700**. State C is set at [0] at initialization, and the following processes branch depending on the content of state C.

When state C is determined to be set at [0] by the check performed in step **#700**, a check is made to determine whether or not image data have been transmitted to an external device by the aforesaid image data transmission process (**#710**). When there are no transmitted data, this routine ends directly. When it is determined there are transmitted image data in step **#710**, a check is made in step **#715** to determine whether or not the flag is set at [0] at least because image data have been transmitted to an external device. This flag is the image data transmission request flags A and B used to determined image data transmission in the previously mentioned image data transmission process. In the paper condition detection process of FIG. **21**, the image data transmission request flag A is set at [0] when both cassettes **81**a and **81***b* are in not empty conditions (i.e., accommodate paper), and when the cassette specified by a job being printed accommodates paper. In the abnormal state Confirmation process of FIG. **22**, the image data transmission request flag B is set at [0] when there are not paper jams or abnormal conditions (abnormality resolved state).

This subroutine ends when the cause of image data transmission has been corrected in step **#715** (**#715**: NO), and the processes of step **#720** and subsequent steps are executed when these abnormal conditions have not been eliminated (**#715**: YES).

In step **#720**, the amount of the data transmitted to the external device is confirmed, and a value expressing this amount is substituted in parameter D. In step **#730**, the available capacity of code memory **306** is confirmed, and a value expressing this available capacity is substituted in parameter E.

Then, in step **#740**, the values of parameters D and E are compared, and when the value of parameter E is larger state C is set at [1] in step **#750** and this subroutine ends, whereas when parameter D is larger this subroutine ends directly.

When it is determined that state C is set at [1] in step **#700**, a process is executed in step **#760** to return image data previously transmitted to the external device back from the external device. Then, a determination is made as to whether or not the return of image data has been completed (**#770**). When the return of image data has been completed, state C is set at [0] in step **#780**, and this subroutine ends, whereas this subroutine ends directly of the return of image data is not complete.

When the cause of the image data transmission (e.g., out-of-paper condition, paper jam condition other abnormal condition) has been corrected, image data which were transmitted to an external device on the network are returned via the process of the aforesaid subroutines on the condition that there is sufficient capacity available in code memory **306**. In this way printing can be easily restarted without requiring an operator to again input image data in order to restart printing.

FIG. **19** is a flow chart showing another example of an image data return process. In the drawing, step numbers in common with FIG. **18** are identical steps and are not described further.

In this subroutine, the process of step **#717** is substituted for step **#715**, and other processes are identical to those of FIG. **18**.

In step **#717**, a determination is made as to whether or not the power source timing is active. When the power source timing has not changed form OFF to ON in **#717** (**#717**: NO), this subroutine ends directly, whereas when the power source timing has changed from OFF to ON (**#717**: YES), the processes of steps **#717** and subsequent steps are executed.

When the power source of digital copier **1** is turned ON, image data previously transmitted to an external device on the network are returned from said external device via the aforesaid processes on the condition that sufficient capacity is available in code memory **306**. In this way printing can be easily restarted without requiring an operator to again input image data in order to restart printing.

Other processes (**#47**) of the main flow chart (**#14**) of CPU **4** are described below with reference to FIGS. **20**~**23**.

FIG. **20** is a subroutine of the content of other processes (**#47**), and in this subroutine other processes are executed including paper condition detection process (**#100**), abnormal state Confirmation process (**#110**), power OFF control (**#120**) and the like, and thereafter various communication processes with the other CPUs are executed such as the abnormal condition detection process (**#130**), power source condition detection process (**#140**) and the like, whereupon this subroutine ends. Various abnormal conditions such as paper jams and other abnormal conditions are detected in the abnormal condition detection process (**#130**), and the controls of the detection processes are well known and therefore omitted form this description. In the power source condition detection process (**#140**), the operational condition of the relay switch of the power source is checked, and changes from ON to OFF state as well as OFF to ON state are detected. The content of each subroutine is described below.

FIG. **21** is a flow chart showing the content of the subroutine of the paper condition detection process (**#100**).

When this subroutine is executed, first, in step **#1000**, a process is executed to confirm the condition of paper sensors **10**E and **11**E.

Then, in step **#1010**, a determination is made as to whether or not an out-of-paper condition exists (i.e., whether or not paper cassette **81***a* or **81***b* is empty) based on the output of sensors **10**E and **11**E. When both sensors detect an out-of-paper condition, the image data transmission request flag A is set at [1] in step **#1050**, and this subroutine ends. The information of flag A is transmitted to CPU **3**, and a process to transmit image data together with said flag A information is executed (FIGS. **16** and **17**).

When the determination in step **#1010** is negative (**#1010**: NO), a determination is made in step **#1020** as to whether or not both sensors **10**E and **11**E have detected "not empty" conditions (i.e., both cassettes **81***a* and **81***b* contain paper). When both sensors detect a "not empty" condition, the image data transmission request flag A is set at [0] in step **#1060**, and this subroutine ends.

When the determination in step **#1020** is negative (**#1020**: NO), a determination is made as to whether or not a sensor detects an out-of-paper condition for the cassette being used for a currently executing print job (i.e., the currently used cassette is empty) in step **#1030**. When an out-of-paper condition is detected, the image data transmission request flag A is set at [1] in step **#1050**, and this subroutine ends.

When the determination in step **#1030** is negative (**#1030**: NO), a determination is made as to whether or not a sensor has detected an out-of-paper condition for the cassette specified for the next print job (i.e., the specified cassette is empty) in step **#1040**. When an out-of-paper condition is detected, the image data transmission request flag A is set at [1] in step **#1050**, and this subroutine ends.

When the determination in step **#1040** is negative (**#1040**: NO), the image data transmission request flag A is [0] in step **#1060**, and this subroutine ends.

The image data transmission request flag A is set at [1] when both cassettes **81***a* and **81***b* are out of paper, when the cassette currently used for printing is out of paper, and when the cassette specified for the next print job is out of paper. When the aforesaid condition is corrected by replenishing paper in the cassette, the image data transit request flag A is set at [0]. Although the example of the present embodiment provides two paper cassettes, it is to be noted that the procedure is identical when three or more cassettes are provided. In such instances, the condition of the sensors for the specified number of cassettes is monitored in the processes of steps **#1000–#1020**. Furthermore, although the presence/absence of paper is monitored in the present embodiment as one example of paper condition detection, the present invention is not limited to this mode inasmuch as image data may be transmitted when paper is out based on a desired paper size or type. Image data may also be transmitted when the remaining paper falls below a predetermined amount rather than completely empty.

FIG. **22** is a flow chart showing the content of abnormal state Confirmation process subroutine (**#110**).

When this subroutine is executed, a determination is made as to whether or not a paper jam has occurred in step **#1100**. When a paper jam has occurred, the image data transmission request flag B is set at [1] in step **#1130**, and this subroutine ends. The information of flag B is transmitted to CPU **3**, and the process for transmitting image data together with the information in CPU **3** is executed (FIGS. **16** and **17**).

When it is determined that a paper jam has not occurred in step **#1100**, it is determined that an abnormal condition (trouble) has not occurred in step **#1110**. Possible abnormal conditions include abnormal conditions of the fixing unit such as fixing heaters shut OFF abnormal temperature regulation and the like, abnormal conditions of the document scanning unit such as out-of-step scanner motor and the like, and more general problems of the digital copier such as out-of-toner condition, eraser lamp shut OFF and the like.

When an abnormal condition is determined in step **#1110**, the image data transmission request flag B is set at [1] in step **#1130**, and this subroutine ends. When an abnormal condition is not determined, the image data transmission request flag B is set at [0] in step **#1120**, and this subroutine ends.

When a paper jam or other abnormal condition (trouble) occurs, the image data transit request flag B is set at [1], and when the jam or abnormal condition is corrected, the image data transmission request flag B is set at [0] by the aforesaid process.

FIG. **23** is a flow chart showing the content of the power source OFF control (**#120**) subroutine.

When this subroutine is executed, first, a determination is made in step **#1200** as to whether or not a print operation has been stopped. If a print operation has been stopped, the state is set at [0] in step **#1210**. Then, in step **#1215**, the power OFF timer stop and timer value is cleared and reset at [0], and in step **#1220** the power OFF request is cleared and this subroutine ends.

When a print operation has stopped in step **#1200**, a determination is made in step **#1205** as to whether or not operation panel **800** has been operated. If the operation panel has not been operated, the processes of step **#1245** and subsequent steps are executed. When the operation panel has been operated, the processes of steps **#1210**, **#1215**, and **#1220** are executed, and this subroutine ends.

When it is determined that the operation panel has not been operated in step **#1205**, the state is confirmed in step **#1225**, and the subroutine branches to the processes described below. When a power ON state is determined, initialization values of [0] are set in the main flow of CPU **4** (FIG. **14**).

First, when the state is set at [0], the power OFF timer is started in step **#1230**, and the state is set at [1] in step **#1235**, and this subroutine ends.

When the state is set at [1], a check is made to determine whether or not the power OFF timer value is less than a predetermined value in step **#1240**. When the power OFF timer value is less than a predetermined value, the power OFF timer is incremented in step **#1245**, and this subroutine ends, whereas when the power OFF timer value is not less than a predetermined value, a power OFF request is output, and this subroutine ends.

A power OFF request is output when there the operation panel has not been operated for a predetermined time following a print operation stoppage. This information is transmitted to CPU **3**, and CPU **3** execute processes to transmit this information together with image data (FIG. **17**). When a power OFF request is received, the power OFF process is actually executed after a predetermined time in the other processes of step **#150** shown in FIG. **20**.

The present invention provides that image data are transmitted to an external device connected to the network in conjunction with a paper jam, predetermined paper supply condition such as an out-of-paper condition, or other abnormal condition. In this way jobs are not erased unbeknownst to an operator when power is automatically shut OFF due to lack of operation for a predetermined time following a print operation stoppage, or when power is shut OFF in conjunction with the correction of a paper jam or other abnormal condition.

The present invention further provides that when the cause of the image data transmission (e.g., out-of-paper condition, paper jam, other abnormal condition) has been corrected or when power is restored to the digital copier **1**, the image data previously transmitted to an external device on the network are returned to the digital copier **1**. In this way printing can be easily restarted by executing a restart continuous operation process without requiring an operator to again input image data in order to restart printing.

The present invention further provides that image data is transmitted to an external device connected to the network on the condition that there has not been any operation of the digital copier **1** for a predetermined time during said transmission. Therefore, data transmission is executed only when there has not been any operation for a predetermined time, thereby preventing unnecessary transmission to an external device.

In the present invention, A single input document or plurality of input documents are stored as one or a plurality of jobs in single job units, and said plurality f jobs on standby are transmitted during the aforesaid transmission time, and are returned to the digital copier and restarted. Accordingly, the cumbersome operations of setting modes and re-entering image data for said plurality of jobs is reduced when restarting the jobs.

In the present invention, the presence/absence of an external device capable of transmitting is confirmed when transmitting image data to an external device, and a warning is displayed when a transmission-enabled external device is not present. Therefore, the possibility of data loss is provided to a user beforehand.

Although the present invention has been fully described by way of examples with reference to the accompanying drawings, it is to be noted that various changes and modification will be apparent to those skilled in the art. Therefore, unless otherwise such changes and modifications depart from the scope of the present invention, they should be construed as being included therein.

What is claimed is:

1. An image forming apparatus, comprising:

a memory for storing image data;

an image forming unit for forming an image on a recording medium based on the image data stored in said memory;

a communication unit;

a detector for detecting trouble relating to said recording medium; and

a controller for transmitting image data from said memory to an external device via said communication unit when trouble is detected by said detector, and for subsequently receiving from said external device via the communication unit after said trouble has been cleared, the image data which had been previously transmitted by said communication unit to said external device.

2. An image forming apparatus as claimed in claim 1,

wherein said trouble relating to the recording medium is a jam of the recording medium.

3. An image forming apparatus as claimed in claim 1, further comprising:

a storing unit for storing a plurality of recording mediums;

wherein said trouble relating to the recording medium is detected when said storing unit for storing a plurality of recording mediums is empty.

4. An image forming apparatus as claimed in claim 1,

wherein said controller transmits the image data when a predetermined time has elapsed without operation after detection of the trouble.

5. An image forming apparatus as claimed in claim 1, further comprising:

an image reader for reading document images;

wherein said memory stores a plurality of jobs, each job including a single document image or a plurality of document images read by the image reader.

6. An image forming apparatus as claimed in claim 1, further comprising:

determination means for determining the presence/absence of an external device to which the image data can be transmitted from the image forming apparatus.

7. An image forming apparatus as claimed in claim 6, further comprising:

warning means for warning when said determination means determines the absence of the external device.

8. An image forming apparatus as claimed in claim 1, wherein said controller includes:

a detector for detecting an available memory storage capacity and the amount of the transmitted image data;

wherein said controller receives the transmitted image data when the available memory storage capacity is more than the amount of the transmitted image data.

9. An image forming apparatus as claimed in claim 1,

wherein said external device is an image forming apparatus.

10. An image forming apparatus, comprising:

a memory for storing image data;

an image forming unit for forming an image on a recording medium based on said image data stored in said memory;

a communication unit;

a power source condition detector for detecting an ON/OFF condition of a power source;

a trouble detector for detecting trouble relating to said recording medium; and

a controller for transmitting image data from said memory to an external device via said communication unit when trouble is detected by said trouble detector, and for subsequently receiving from said external device via said communication unit when a change in the power source from an OFF condition to an ON condition is detected by said power source condition detector, the image data which had been previously transmitted by said communication unit to said external device.

11. An image forming apparatus as claimed in claim 10,

wherein said trouble relating to the recording medium is a jam of the recording medium.

12. An image forming apparatus as claimed in claim 10, further comprising:

a storing unit for storing a plurality of recording mediums;

wherein said trouble relating to the recording medium is detected when said storing unit for storing a plurality of recording mediums is empty.

13. An image forming apparatus as claimed in claim 10,

wherein said controller transmits the image data when a predetermined time has elapsed without operation after detection of the trouble.

14. An image forming apparatus as claimed in claim 10, further comprising:

an image reader for reading document images;

wherein said memory stores a plurality of jobs, each job including a single document image or a plurality of document images read by the image reader.

15. An image forming apparatus as claimed in claim 10, further comprising:

determination means for determining the presence/absence of an external device to which the image data can be transmitted from the image forming apparatus.

16. An image forming apparatus as claimed in claim 15, further comprising:

warning means for warning when said determination means determines the absence of the external device.

17. An image forming apparatus as claimed in claim 10, said controller including:

a detector for detecting an available memory storage capacity and the amount of the transmitted image data;

wherein said controller receives the transmitted image data when the available memory storage capacity is more than the amount of the transmitted image data.

18. An image forming apparatus, comprising:

a memory which stores image data;

an image forming unit which forms an image by operating a plurality of image forming elements;

a communication unit;

a detector which detects trouble relating to at least one among said plurality of said image forming elements; and

a controller which transmits image data from said memory to an external device via said communication unit when trouble is detected by said detector, and subsequently receives from said external device via said communication unit after said trouble has been cleared, the image data which had been previously transmitted by said communication unit to said external device.

19. An image forming apparatus as claimed in claim 18,

wherein said controller transmits the image data when a predetermined time has elapsed without operation after detection of the trouble.

20. An image forming apparatus as claimed in claim 18, further comprising:

an image reading apparatus for reading document images;

wherein said memory stores a plurality of jobs, each job including a single document image or a plurality of document images read by the image reading apparatus.

21. An image forming apparatus as claimed in claim 18, further comprising:

determination means for determining the presence/absence of an external device to which the image data can be transmitted from the image forming apparatus; and

warning means for warning when said determination means determines the absence of the external device.

22. An image forming apparatus as claimed in claim 18, wherein said controller includes:

a detector for detecting an available memory storage capacity and the amount of the transmitted image data;

wherein said controller receives the transmitted image data when the available memory storage capacity is more than the amount of the transmitted image data.

23. An image forming apparatus as claimed in claim 18,

wherein said memory stores a plurality of jobs, and wherein said controller transmits image data of a plurality of jobs.

24. An image forming apparatus, comprising:

a memory which stores image data;

a communication unit;

a power source condition detector which detects an ON/OFF condition of a power source;

a trouble detector which detects trouble relating to said apparatus; and

a controller which transmits image data from said memory to an external device via said communication unit when trouble is detected by said trouble detector, and subsequently receives from said external device via said communication unit when a change in the power source from an OFF condition to an ON condition is detected by said power source condition detector, the image data which had been previously transmitted by said communication unit to said external device.

25. An image forming apparatus as claimed in claim 24,

wherein said controller transmits the image data and the power source is turned OFF when a predetermined time has elapsed without operation after detection of the trouble.

26. An image forming apparatus as claimed in claim 24, further comprising:

an image reading apparatus which reads document images;

wherein said memory stores a plurality of jobs, each job including a single document image or a plurality of document images read by the image reading apparatus.

27. An image forming apparatus as claimed in claim 24, further comprising:

determination means for determining the presence/absence of an external device to which the image data can be transmitted from the image forming apparatus; and

warning means for warning when said determination means determines the absence of the external device.

28. An image forming apparatus as claimed in claim 24, said controller including:

a detector for detecting an available memory storage capacity and the amount of the transmitted image data;

wherein said controller receives the transmitted image data when the available memory storage capacity is more than the amount of the transmitted image data.

29. An image forming apparatus as claimed in claim 24,

wherein said memory stores a plurality of jobs, and said controller transmits image data of a plurality of jobs.

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